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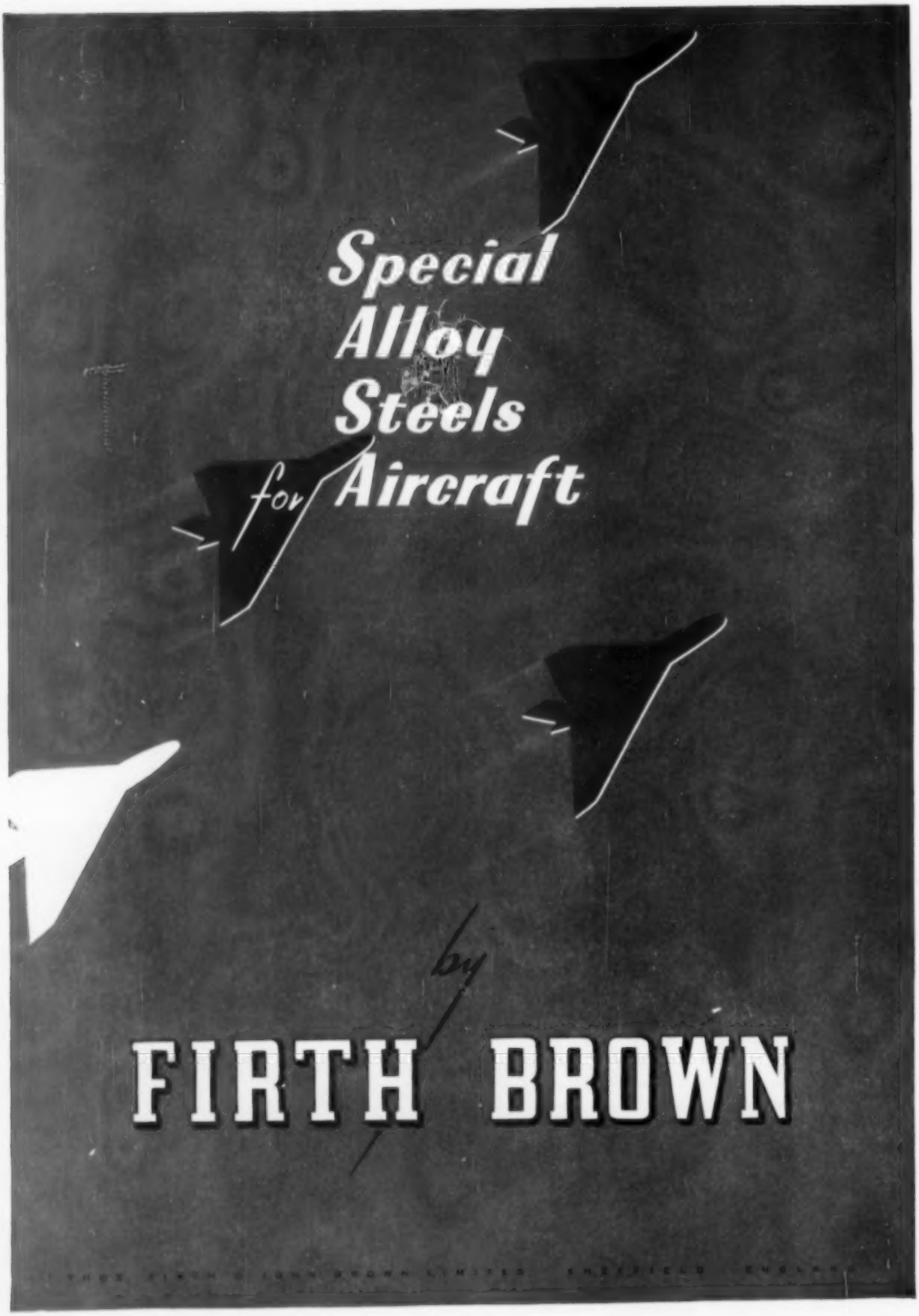
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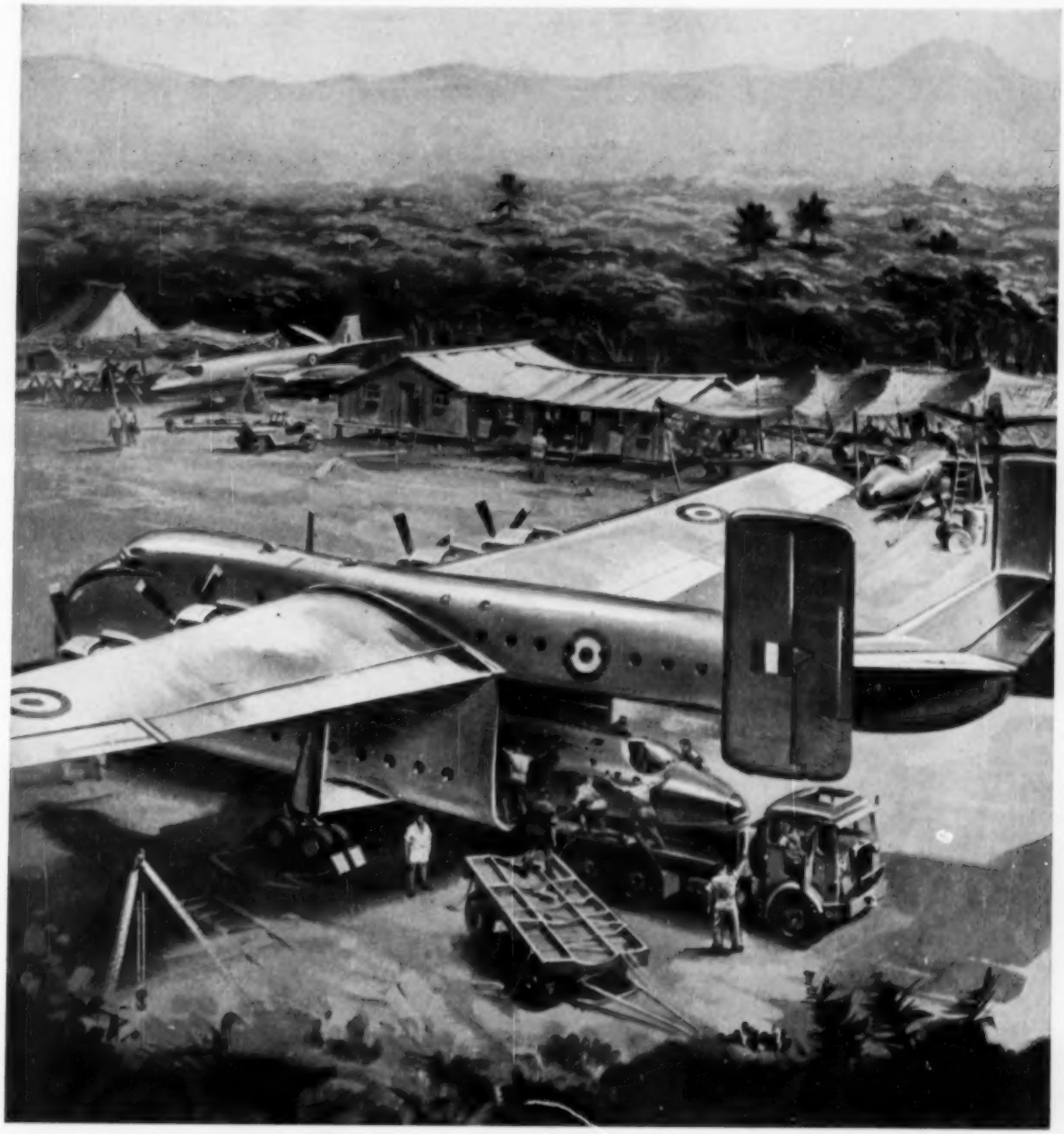

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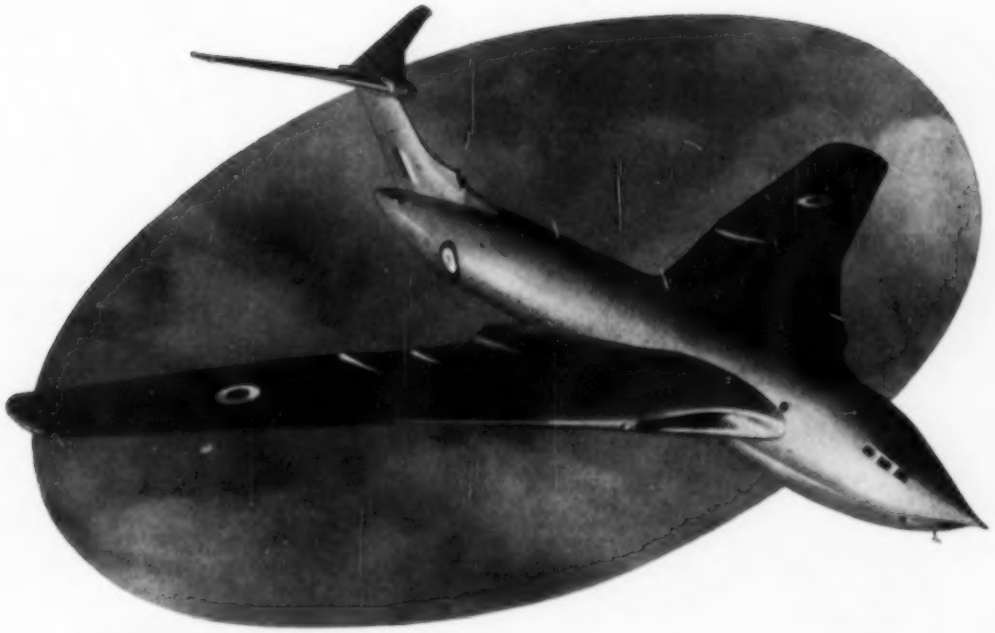

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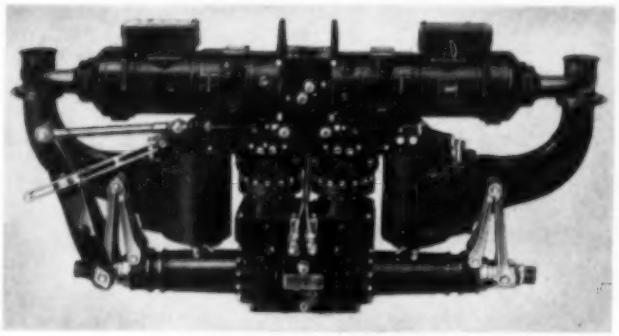

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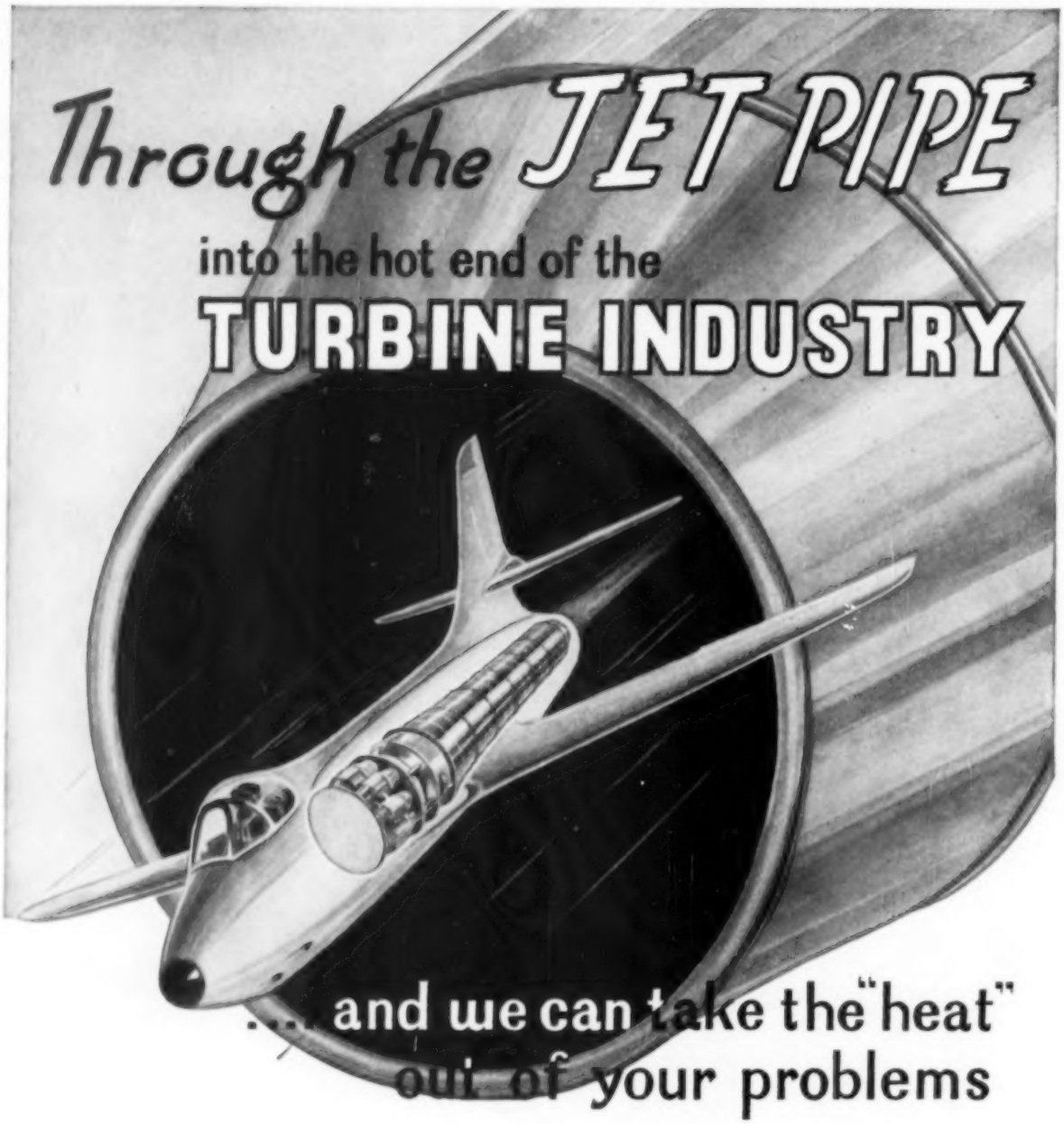

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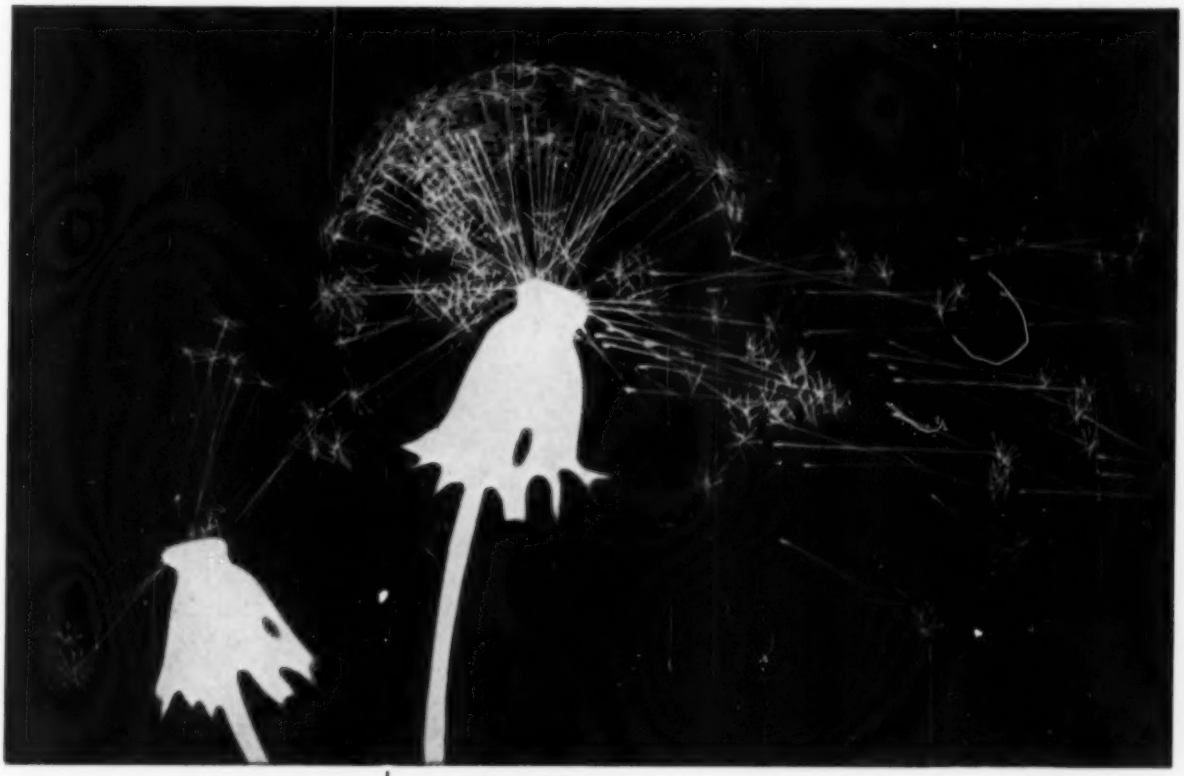

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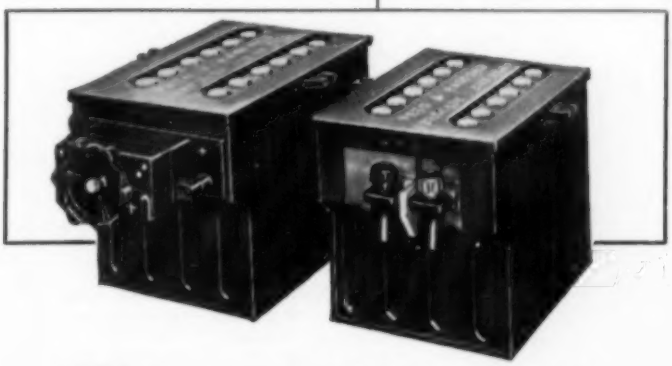

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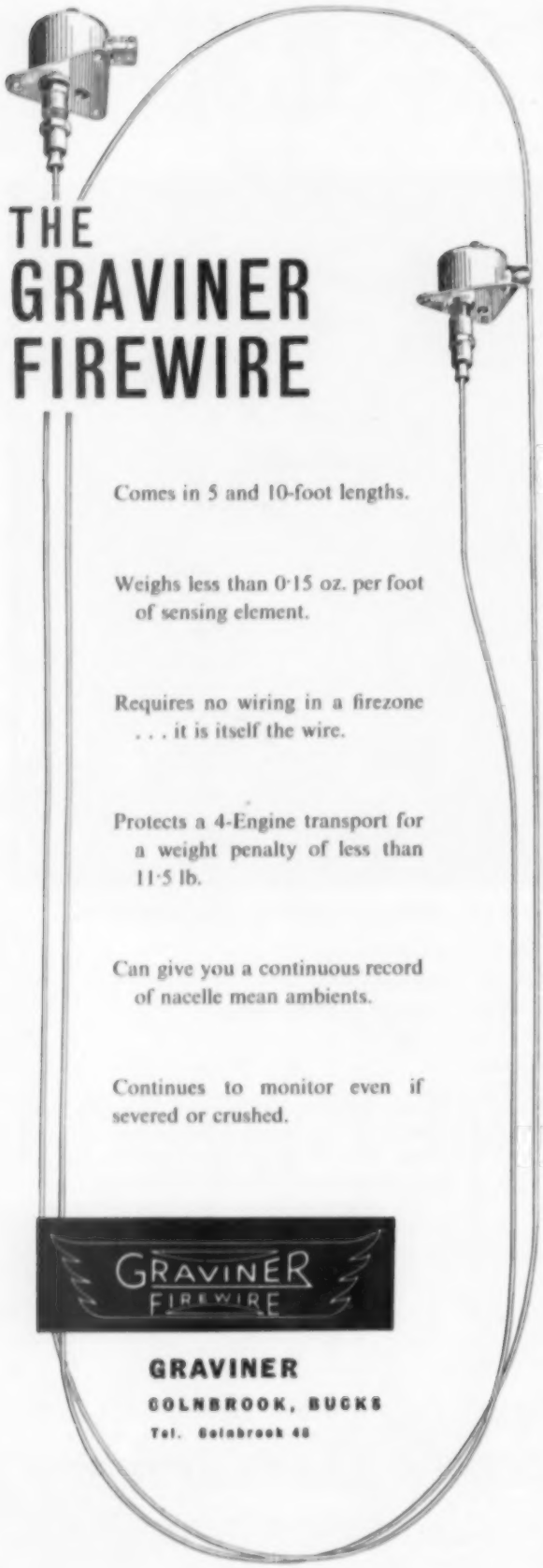

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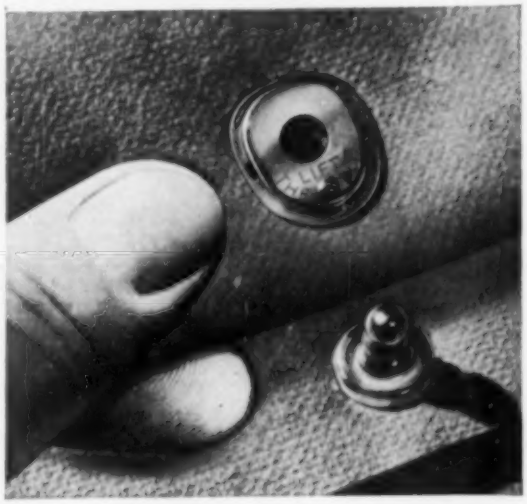

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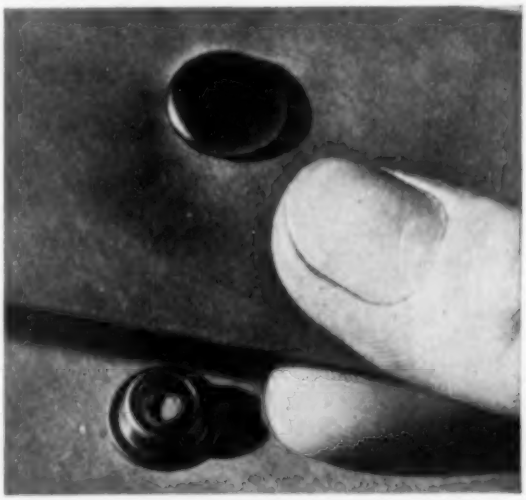

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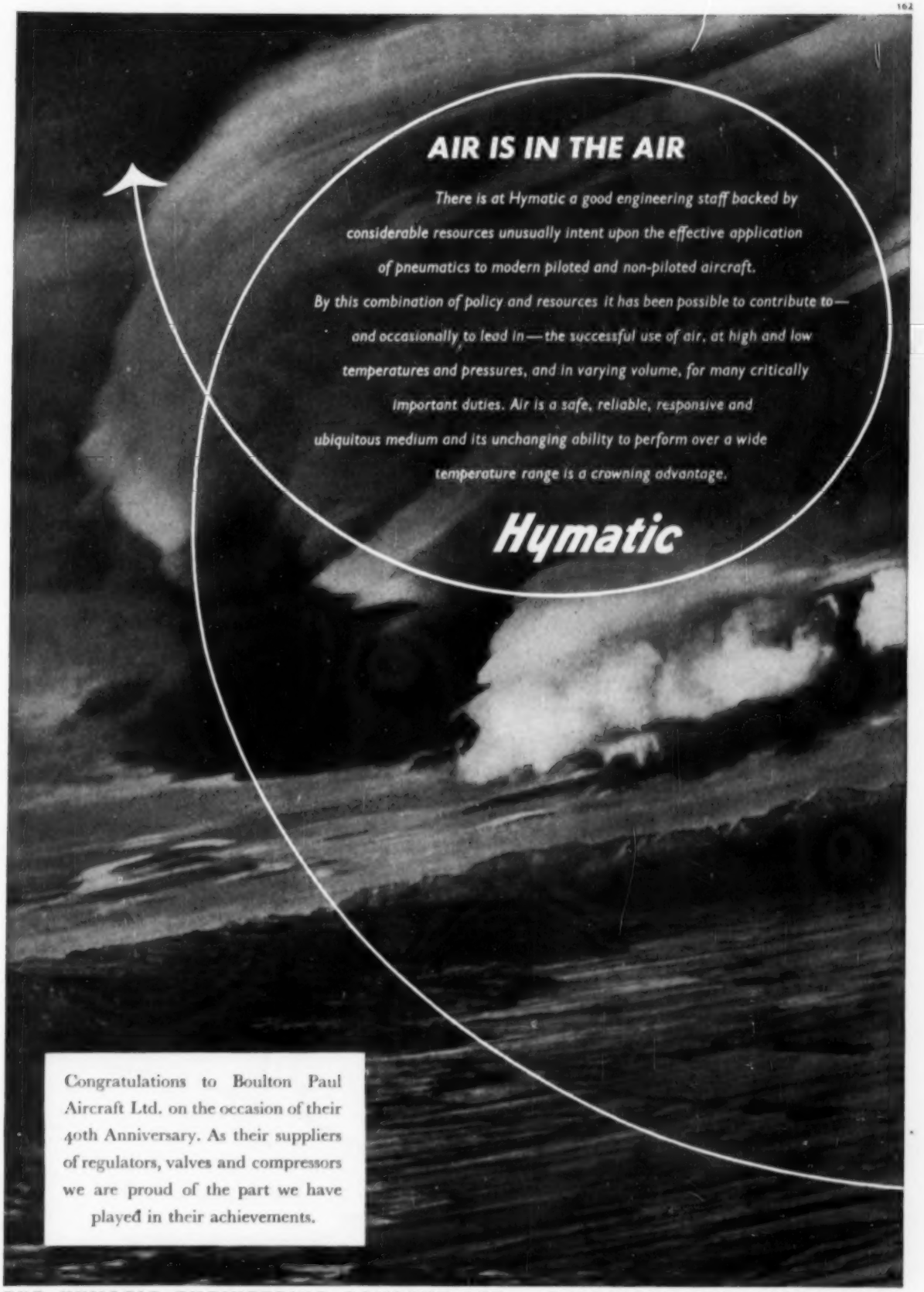
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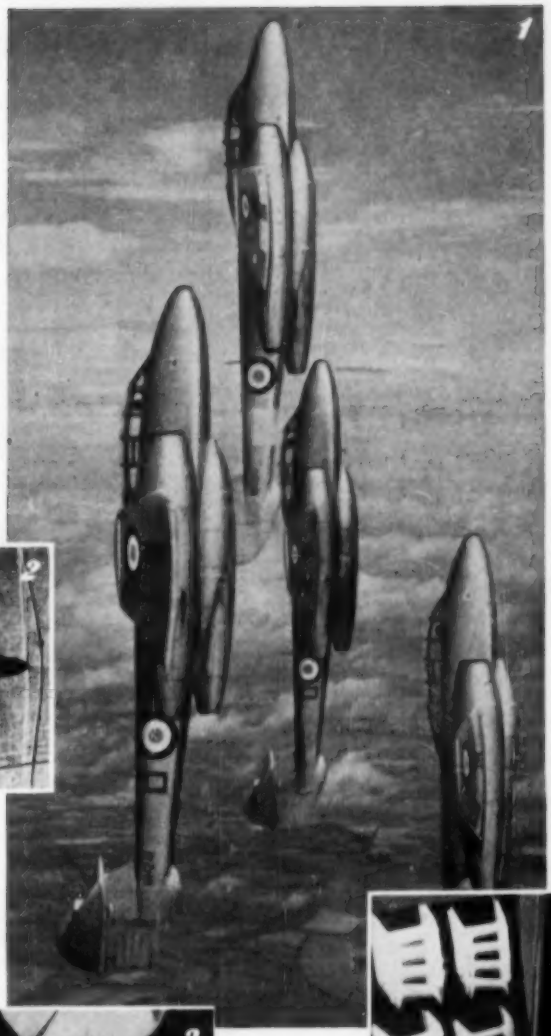

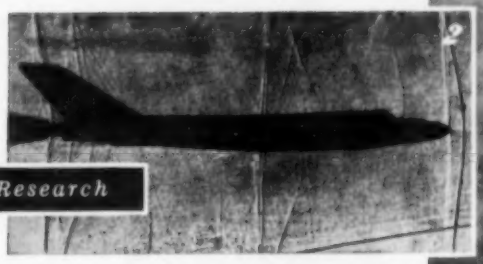

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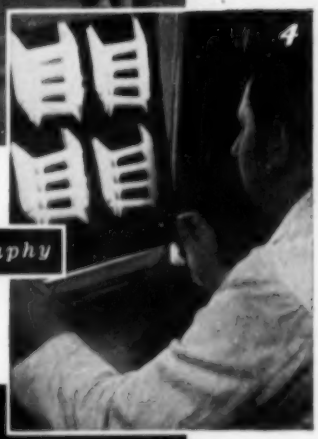

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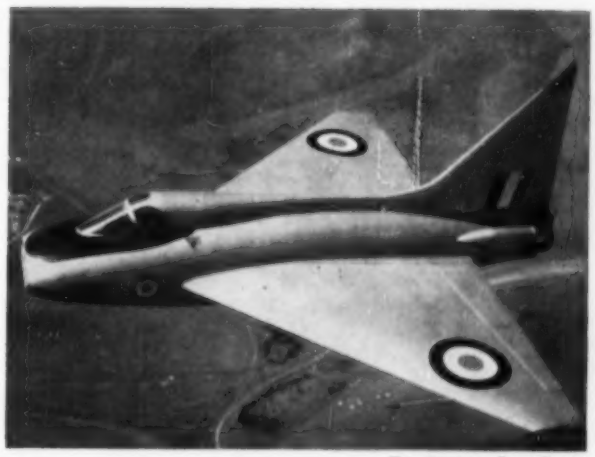

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Age and Experience

AVIATION is growing up. This year of 1955 has already brought more noteworthy anniversaries in the British aircraft industry than any we can remember previously. In May we reviewed the first 40 years' activities of one major manufacturer, Gloster Aircraft, and in the previous month 40 years of Westland Aircraft—an occasion which, incidentally, the company itself marked last week with a garden party near London. Feature articles in our last week's issue led up to another even greater occasion which is now being celebrated, namely, the golden jubilee of the Royal Aircraft Establishment (as it is now styled) at Farnborough. And this is not all; the history to date of another respected company, Boulton Paul, is also reviewed in some of the following pages; and a little later in the month it will be the turn of Fairey Aviation, with another fortieth anniversary.

Farnborough, towards which today many will turn their steps (and many more, no doubt, their thoughts) has a remarkable record of service to the aircraft manufacturing industry and, more broadly, to the nation. This was made clear in the tributes and reminiscences, printed last week, from men associated with Farnborough, some of whom had actually worked there. The near-miraculous investigation into the Comet disasters, also, is still in the public mind; so that while some may believe that the Establishment, now in its 50th year, is no more than a sort of super, technical Scotland Yard for aviation, they at least have an appreciation of the standard of work and the calibre of the men of Farnborough.

Today the work of the R.A.E. and of similar scientific and research centres is more important to the country than ever previously. That Princess Margaret has found it possible to include among her engagements an inspection of the activities and equipment displayed at Farnborough on the occasion of its jubilee celebrations is particularly gratifying.

Enterprise—and Risk

Turning again for a moment to the histories of aircraft manufacturers which we prepare from time to time as the jubilees occur, it is instructive to observe the rewards for enterprise—and also the cost. The facts are often cruel, but they give grounds for encouragement; many excellent ideas and aircraft designs of past years have failed, some disastrously, and most expensively. On the other hand, some have succeeded brilliantly and brought fame, prestige and reward. One thing clearly brought out is well expressed by the old adage "nothing venture, nothing gain". We are well aware how easy it is to write about such matters and in contrast how overwhelming a responsibility is the taking of a decision to build a new aircraft today; but courage and enterprise there must be, and with the store of knowledge and experience now built up, the chances of success in a vastly more complicated undertaking are at least as good as they were in the past.

Once the difficult decision has been taken to proceed with a new aircraft to suit a definite market at a definite time the technical battle begins, and it is here that Farnborough enters the picture. From the R.A.E. manufacturers can depend upon obtaining a great deal of advanced basic data of a kind that they could seldom hope to provide from their own sources. In addition, they can later take individual problems to Farnborough as they arise during construction and development and be sure of help in their solutions.

And so, eventually, the finished product emerges and flies, and in due course (very appropriately, we have often thought) finds its way back to Farnborough again for a different purpose—its demonstration to prospective purchasers from all parts of the world who assemble there each September as the guests of the Society of British Aircraft Constructors. So the cycle is completed.

FROM ALL QUARTERS

Soviet Aviation Day

NEW manifestations of Soviet strength and technical development were afforded by Aviation Day, celebrated throughout the Soviet Union last Sunday, July 3rd. Activities centred on Tushino Airfield, and the propaganda build-up was on a much larger scale than before. Its theme was that Soviet aviation is the best in the world. Present were representatives of the air forces of China, Albania, Bulgaria, Hungary, Korea, Poland and Czechoslovakia; General Zdenko Ulepic, C-in-C. of the Yugoslav Air Force; Air Marshal S. Mukerjee, C-in-C. of the Indian Air Force; and—from the F.A.I.—the president, Capt. K. Bartlett, director-general, Mr. H. Gillman, and Jean Blériot, son of Louis Blériot.

On the evening of July 2nd a meeting was held at the open-air theatre of the Gorky Park of Culture and Rest. Principal speaker was Chief Marshal of the Soviet Air Force Zhigarev, and among some 20,000 listeners was Marshal Zhukov. Zhigarev said that the U.S.S.R. had aircraft capable of "unprecedented long-range flights," adding "We have the best specialists in precision bombing." The Soviet Minister for Aviation Industry, P. V. Dementyev, mentioned "unprecedented" aircraft, now being developed.

At Tushino, cloud-base was about 6,000ft, with occasional patches of blue. The proceedings opened at 10 a.m. with the Soviet national anthem and a salvo of artillery, and as the gunfire died there appeared nineteen Yak-12s, displaying the portraits of Lenin and Stalin and the flags of the sixteen Soviet Republics. Higher, and slightly behind, came seventy-six machines of the same type, in a formation spelling "Glory to the C.P.S.U." (Communist Party of the Soviet Union). Then, led by Lt-Gen. of the Air Force (and Hero of the Soviet Union) Timofei Fedorovich Kutsevalov, nine Yak-18s performed aerobatics; with the exception of the leader, all the pilots were women, some of whom flew in the war. Twenty-four Yak-18s were led by "Master of Stunt Flying" Nikolai Golovanov, and formed themselves into a "merry-go-round, in which the twenty-four aircraft flew over the airfield in a never-ending circle, performing aerobatics all the time"; and next followed several Antonov AN-2 biplanes, each towing three AN-9 gliders. These latter were released at 900 metres, and performed group and individual aerobatics. When all had landed, Yuri Abramov was winched up in a glider to perform over the crowd.

During a short interval, filled with martial music, poems and demonstrations of radio-controlled aerobatics by model aircraft, it was remarked that a model built by Sergei Malik, a Moscow Aviation Institute student, had established a world record by flying 210 km.

Then appeared the flapping-wing glider, towed by an AN-2. On tow the wings remained fixed, and flapping began only with the release of the cable. The announcer found time to say that the whole display was being controlled from the Tushino tower by Lt-Gen. of the Air Force Stepan Ulyanovich Rubanov.

A new phase produced a "Mikoyan jet fighter" flown by Major Valentin Lapshin, who performed aerobatics before making way for more formation aerobatics by three jets, led by Lt-Col. Babayev (260 war-time sorties, ten victories). Three more appeared on two opposing sides of the field, met over the centre and climbed vertically away into cloud; then nine, led by Col. Shulgenko (280 war-time sorties, 16 victories) contributed more aerobatics. A long column of jet bombers had an escort of jet fighters, and was followed by waves of heavy jet bombers, also escorted. In the lead was one of Russia's greatest pilots, Yuri Lok.

The third phase began with "air landings" controlled by Lt-Gen. of the Air Force Vasily Selivanovich Margelov. First some fifty helicopters, among them four large twin-rotor machines, never previously seen, arrived in formation, landed, and disgorged fully armed troops. From the large ones, too, came several guns.

The sky clear again, a flight of Il-12s dropped parachutists, and there followed precision drops from Yak-18s, wherein each man used a "new type of stabilized parachute," demonstrated for the first time. Then stick after stick of parachutists filled the sky with multi-coloured canopies. In addition to full equipment each man wore a Mae West. Two came down in the river, and several among the crowd.

The commentator next drew attention to a jet aircraft appearing over the horizon. "It is our new jet passenger plane," he said. "Such machines have not yet been seen in any of our previous displays." The pilot's name was announced as Alaseyev, and the commentator said that jet aircraft had been used in the Soviet air fleet for "some time" to fly matrices of national newspapers to the Far East cities, so that readers could have their Moscow papers on the same day as the Muscovites. These, however, were jet freighters only, though it could be assumed that before long the air highways of Russia would be served by spacious and comfortable passenger jet planes.

Although trainers and certain other types of aircraft were referred to by name, no designations were given for the jet bombers and fighters. These are said to have included, twelve "Bisons" (four-jet heavy bombers); fifty-four "Badgers" (twin-jet medium bombers); forty-eight swept-wing fighters corresponding to the North American Super Sabre; fifty twin-jet all-weather fighters; twenty-three Mig-17s; and seven swept-wing bombers powered by four turboprops.

Igor Merkulov, chairman of the Scientific and Technical Committee for Jet Propulsion, described some foreign aircraft in a broadcast. The Avro Vulcan, he said, had an all-up weight of 68 tons and a speed of 1,100 km/hr; and, having climbed into the stratosphere, it could fly 8,000 km (5,770 miles) non-stop. He named the Soviet jet freighter which carried the newspaper matrices as the Il-20. In another broadcast, Boris Nikolayevich Yuryev, a member of the Soviet Academy of Science, said that Comrades Bratushin, Mil and Kamov were working on helicopters, and added that Soviet designers were responsible too for developing the convertiplane.

Bristol Design Organization

SEVERAL changes in the design-executive organization of the Bristol Aeroplane Company's aircraft division were announced last week. They are effective from July 1st. Dr. W. J. Strang is appointed chief designer (fixed-wing aircraft) and with Mr. R. Hafner (chief designer, helicopters) and Mr. D. J. Farrar (chief designer, guided weapons), will be responsible to Dr. A. E. Russell, who relinquishes the title of chief designer and assumes that of chief engineer (aircraft division).

DESIGN CHIEFS: Dr. W. J. Strang (left) and Mr. D. J. Farrar, two of the Bristol executives referred to above.

THE WHITE COMPANY: Resplendent stand the four Bristol Britannias now engaged on flight development tests. Latest of the line is the third production aircraft, G-ANBC (at far end of apron), which made a 30-minute maiden flight on June 29th with "Bill" Pegg at the controls. Britannia test hours now total 1,800.

Dr. Strang, who is 34, joined the company's aerodynamics department in 1939 and later moved to the stress and project stress offices, working on the Beaufort, Beaufighter, Buckingham and Brabazon aircraft and on Bristol gun turrets. In 1946 he left to take up scholarships at Kings College, London, and from 1948-51 was with the Aeronautical Research Laboratory at Melbourne, Australia. He returned to Filton in 1951 as deputy head of the guided weapons department, and in the following year took charge of the aerodynamics and flight research and development departments.

The work of Dr. Russell and Mr. Hafner is well known, but a note may be added on that of Mr. Farrar. Thirty-four years of age, he joined Bristols in 1941 as a member of the project stress office team working on the Brabazon project and in due course became structures designer for the Brabazon 1 and 2, subsequently assuming responsibility for all structural design. When the company's guided weapon unit was formed in 1949 he was appointed its assistant chief designer, and since then has been responsible for guided-weapon development. He holds a Private Pilot's licence and is a founder-member of the post-war Bristol Gliding Club.

Avro's New Chief Designer

AS briefly announced last week, Mr. J. R. Ewans, A.C.G.I., B.Sc., D.I.C., A.F.R.Ae.S., has succeeded Mr. S. D. Davies as chief designer to A. V. Roe and Co., Ltd. Born on December 21st, 1917, John Roy Ewans was educated at St. Paul's, Kensington, and graduated at the Imperial College with an honours degree in mechanical engineering. A post-graduate course in aeronautics led to an appointment, in 1938, at the R.A.E., where for six years he concentrated on aerodynamic research. In 1944 he was a member of a team of investigators sent to France and Germany, and in 1946 he joined the Blackburn Aircraft Company as head of the aerodynamics section of the design office. In October 1949 he was appointed chief aerodynamicist to A. V. Roe and Co., and in May this year became deputy chief designer. His present appointment as chief designer dates from June.

Mr. J. R. Ewans

The Javelin Rumpus

THAT the Gloster Javelin all-weather fighter "is displaying serious defects and, in its present form, could never be put into front-line service" was asserted last week-end in the *Sunday Express*. The fighter was said to have been given a few weeks grace; then the Ministry of Supply, the Air Ministry and the Ministry of Defence would have to decide on its future. Everything depended upon whether a simple modification could be found quickly. It was further reported that more than £20 million had been spent on developing the Javelin and that the type had "undesirable and sometimes alarming" characteristics at high altitudes and speeds near that of sound. Reference was made to three Javelin crashes, two of which were fatal (Peter Lawrence and F/L. R. J. Ross).

The story, which carried the front-page headline "New Fighter Shock," quickly called forth a rejoinder by the Hawker Siddeley Group and the comment "Pure tripe" from Sir Frank Spriggs. A Group statement ran: "The Gloster Javelin will be delivered to the R.A.F. this year. It is in fine shape and the development programme is going very well indeed. There is absolutely no truth in the irresponsible, mischievous, and totally inaccurate report in the *Sunday Express* that there is a Javelin crisis."

The statement went on to make a number of detailed points: (1) Deliveries will be made this year to the R.A.F. as planned. (2) There are no grave defects or alarming characteristics at high speed or high altitude; indeed, the Javelin performance in almost all respects is better than original design expectations, and this includes speed, take-off, landing and high Mach number performance. (3) The normal manufacturer's acceptance trials have been going on at Boscombe and Farnborough for months; there is no special probe. These trials are usual in every way. At the moment, wing airflow is being checked. (4) There is no "mysterious vice" at critical height or speed. (5) The record of the Javelin crashes, of which there have been three, compares very favourably with that of other high-speed aircraft, both British and American. Aerodynamic reasons for two of the three crashes are fully understood. The reasons for the third crash are also understood, and they are not aerodynamic. (6) There are no outstanding complaints from the Ministries of Supply, Air or Defence. There is no truth in the suggestion that the Javelin has been referred to the Prime Minister. Everyone (and this includes Glosters) wants to get the Javelin into the hands of the R.A.F. as fast as possible. This is being done. (7) It has not cost £20 million to develop the Javelin. (8) There is no similarity between the state of the Javelin and the Swift story, and any attempt to create it is misleading and irresponsible.

***CAPITAL CEREMONY:** At Washington, Mrs. Richard Nixon, wife of U.S. Vice-President, leaves Capital Airlines' first Viscount with her husband after performing the naming ceremony. Following are Mr. J. H. Carmichael, president of Capital; Sir Roger Makins, the British Ambassador and Lady Makins.*

Piasecki's Civil Helicopter

CONFIRMING reports that New York Airways, Sabena and "other operators" are evaluating the H-21 Work Horse twin-rotor, single-engined helicopter, the Piasecki Helicopter Corporation announce that initial civil deliveries are scheduled for 1956. To be designated PH-42, the civil version will seat 19 passengers and cruise at 98 m.p.h. for 338 miles. As a freighter, the PH-42 will lift 5,300 lb of cargo; alternatively, it will be able to carry a suspended load of 4,500 lb when used as a flying crane.

Forward and rear doors are provided on opposite sides of the 20ft cabin, enabling passengers and freight to be embarked separately when the helicopter is operating in a dual-purpose rôle. Mail and baggage can be carried in an 80 cu ft "Helipack" beneath the cabin. The power unit will be an aft-mounted Wright Cyclone 863C9HD-1, delivering 1,425 h.p. for take-off.

***CALIFORNIAN SUNSHINE** beams on these R.Ae.S. delegates—some 80 in number—visiting Douglas' El Segundo plant. The aircraft is an A3-D Skywarrior for the U.S. Navy.*

R.A.E. GOLDEN JUBILEE

Technical Exhibits and Flying Demonstrations

THREE Open Days—July 7th, 8th and 9th—have been planned to mark the Golden Jubilee of the Royal Aircraft Establishment, Farnborough. Admission is by invitation; and yesterday, when the Establishment was host to some five or six thousand people, H.R.H. Princess Margaret was due to arrive by helicopter. Today double the number of visitors is expected (mostly from the aircraft industry); but the third day is to have a more domestic atmosphere.

An ambitious programme had been arranged. The flying display was initiated by a mass start and take-off of Hunters, followed by Hunter aerobatics and a high-speed fly-past. Then a Bristol Fighter and Sopwith Pup were to engage in a dog-fight, while below them the Blériot and Blackburn monoplanes were to show their paces. Fighting and training aircraft of the late 1930s were being shown in a formation, and there were to be aerobatics by a Hart, Gladiator and Swordfish. A Percival Gull would represent contemporary civil aircraft. After a Hurricane *v.* Spitfire dog-fight, a Lancaster, Beaufighter, Mosquito and Wellington were to fly past, to be followed by a mass start, take-off, fly-past and stream landing by Bomber Command Canberras. The Royal Navy was being represented by a formation of helicopters and a squadron of Fairey Gannets, and a Shackleton and Sunderland were scheduled for Coastal Command. There was to be a simulated rescue by helicopter, and demonstrations by a Valiant, Javelin, Comet 3, Vulcan, Victor, Britannia, Jet Provost, Supermarine 525, Fairey delta, Avro 707, Boulton Paul P.111A and—at high and low speed—the English Electric P.1. Meteors of the Central Flying School were to perform aerobatics.

On the ground the Cody aeroplane of 1912, a B.E.2C and an S.E.5A are being shown full-scale, and there are models of the F.E.2D, S.E.5A, B.E.2C, R.E.8, B.E.12, F.E.8, Cody Kite and *Nulli Secundus* airship. Engines include a 50 h.p. Antoinette, 100 h.p. Green, 90 h.p. RAF., 60 h.p. Green and 80 h.p. E.N.V., with, nearby, wooden and metal propellers used by Cody. Outside the exhibition hangar was to be a detachment of Royal Engineers in period uniform (1905), a balloon, full-scale Cody Kites and a limber complete with winch. The historic aircraft park gives space for the Blackburn monoplane, Sopwith Pup, Bristol Fighter, Blériot monoplane, S.E.5A and Avro 504K.

The various departments of R.A.E. are being represented by exhibits as follows: *Aerodynamics Department:* The development of instrumentation for aerodynamic flight tests; Hunter aircraft, showing modern flight-test instrumentation; free-flight models for supersonic flight research; exhibition of flight test information telemetered from aircraft in flight; models of 8ft and 3ft wind tunnels and of the Aero Dept. site at Bedford; research aircraft to be shown on tarmac (S.B.5, 707B, Vampire 343, R.R. Bedstead, Jet-deflection Meteor and Boulton Paul P.111A); caravan take-off and landing camera; Javelin spinning model suspended from kite balloon.

Armament Department: Display of fuses; aircraft machine guns and cannon; rocket projectiles; pyrotechnics; bomb release units; small bombs; model of bombing range; Aden gun installation; exhibit showing gyro gun-sight, correction for deflection, etc.; Aden-gun Hunter on tarmac; Sperrin bombing-up.

Blind Landing Experimental Unit: Model of airfield, showing approach lighting, ILS, PAR and FIDO installations; Ambassador flight simulator.

Chemistry Department: Plastic delta wing; progress in high-rate batteries; fire-detection exhibit; exhibit showing protection against rain erosion; chemical cleaner for sparking plugs; glass fibre drawing machine.

Electrical Engineering: Exhibit showing effects of high altitude on commutator brushwear; commutator profile measuring machine; moving-magnet instrument *v.* conventional; airfield lighting system, exhibited on B.L.E.U. model airfield.

Guided Weapons: Display of test vehicle recovery equipment; assembly line for guided weapons test vehicle; sectioned test vehicle; three test vehicles mounted at an angle; model of missile test range.

Instrumentation: Timing equipment for future attempt on the world air-speed record, to be made at high altitude.

Instrument and Photographic: Type B autopilot; air photography exhibit including cameras and examples of day and night photography; Type 6 processing vehicle outside "A" Shed.

Mathematical Services: Continuous trace plotter with electric typewriter; isograph—electronic equipment for solution of equations.

Mechanical Engineering: Fire bomb—research into the effects of altitude on aircraft fires; pressure suits; ejector seats; hydraulic power services; 7/12,000 lb parachutable platform, loaded with stores, to be supported on air bags on tarmac.

Metallurgy: Exhibit showing cases of fatigue failure in aircraft materials, titanium alloys and their use in aircraft; use of radio-active materials in metallurgical research.

Naval Air: Model of H.M.S. *Triumph*, showing angle deck and mirror-landing sight; working-model catapult and deck, demonstrating arresting of aircraft and the operation of crash barriers; model of H.M.S. *Ark Royal;* model of steam catapult; arrester hook installation demonstrating effect of hook damper.

Radio: Exhibit to demonstrate aerial radiation pattern from an aircraft; radio-controlled target aircraft; sonobuoy demonstration; ARI 18032 HF set; radio altimeter.

Rocket Propulsion: RTV.1; RTV.2; pump display stand; continuously burning oxygen/hydrocarbon diffusion flame; demonstration of the properties of fuels and oxidants; Beta 1 motor; Beta 2 motor; Ladybird motor; Scarab motor; high-speed mechanical torque motor; torsion flowmeter; high-pressure diaphragm pump; Terylene protective clothing; equipment for the measurement of heat transfer; temperature resistant ceramics; erosion rig; development of silver catalysts for hydrogen peroxide decomposers.

Structures: Examples of aircraft structure; models of test frames; display of strain-gauge techniques; counting accelerometer and V-G recorders.

THE A.R.B. YEAR

THE 18th Annual Report of the Air Registration Board—presented by the Chairman, Lord Brabazon, in advance of the annual luncheon, held last Tuesday—opened with a tribute to Sir Maurice Denny, the Board's first chairman, whose death occurred on February 2nd this year. Reference was made to Sir Maurice Denny's remarkable foresight and to his striving for technical independence for the Board.

Under the heading of Technical Problems, Lord Brabazon stated that the Board had passed through the most difficult year in its history due to the nature and extent of the technical problems which had confronted it. Work in connection with the accident to Comet aircraft had dwarfed all other activities in the intensity of effort it had required from the Council's executive and technical staff. A great burden had rested on the Chief Executive and Chief Technical Officer for many months. Fortunately it was within their capacity to shoulder it. Lord Brabazon here paid a personal tribute to Mr. Tye.

In his report of 1952/53 Lord Brabazon wrote: "The outstanding problem continues to be the fatigue of structures which the Board is studying intensively." That statement, he said, was never more true than it was today. An immense amount of work had been done and much knowledge had been gained but there was no short cut and no easy answer. Testing on a very large scale was being undertaken. Experience during the past year had shown that the testing of representative sections of structures was no longer sufficient and full-scale testing of wings and pressurized cabins was now required. The tank test developed by the R.A.E. for local investigation was a powerful tool for testing whether there were seriously weak points in cabins. The Board was very conscious of the heavy expense of such tests and the technical difficulties associated with the interpretation of results. At present there was no alternative for certain new prototypes than that the results of earlier tests should be confirmed in this way. The Board believe that the only real long-term solution was to design structures so that any fatigue failure would be well beyond the operational life of the aircraft and in which if cracks did occur the failure would be non-catastrophic.

The chairman was glad to be able to record the acceptance by the U.S.A. of the British C. of A. for the Viscount. This marked the first American validation of a certificate for a turbine-engined aircraft.

Under the heading "International Civil Aviation Organization"

Lord Brabazon said that the Council of I.C.A.O. had reached the conclusion that International Airworthiness and related Operational Standards should be reviewed with the aim of presenting them in a broader and more objective manner.

The third issue of Section C (Engines and Propellers) of British Civil Airworthiness Requirements was about to be published, the technical preparations and committee work having been completed. A considerable number of amendments were involved, including approval of engines using water-methanol injection, approval of engines with compressor or turbine bleeds, low temperature starting tests and humidity correction factors for piston and turbine engines.

The A.R.B. expected amendments to Section E (Gliders) in the light of proposals from the Technical Department of the B.G.A. and preparatory work was continuing for a second issue of Section G (Rotorcraft).

Certificate of Airworthiness Investigations in hand during the past year were concerned with the Westland S.55, the conversion of Convair 340 and Ambassador to take Napier Eland engines and with the Britannia, various marks of Comet and Viscount, the Beverley, single and twin Pioneers, Accountant and Herald. Reference was also made in the report to the change of policy regarding certification of ultra light aircraft.

The Board had been concerned with the flight testing of 125 aircraft, among which was the Britannia. The Board's chief test pilot, Mr. D. P. Davies and a performance specialist took part in the tropical and high altitude tests of this aircraft. Tropical and other trials were carried out on the York, Hermes and Tudor and tests made on the Britannia, Pioneer, Auster, Viscount 720, Viscount 724, Viscount 737, Heron 2 and Sparrowjet. New gliders tested were the Skylark 2 and the Eon Olympia Mark 4.

On the subject of powerplant development, the chairman reported as follows: "In most installations, the larger British piston engines of relatively recent types now have an excellent record of reliability, which compares favourably with that of the engines of any other constructing country. The Dart turbo-propeller engine in the Viscount is giving an excellent performance in service and a great deal of development work has now been completed with promising results on the Proteus engine for the Britannia. However, with the entry of the axial flow engine in turbo-propeller and turbo-jet form into civil aviation, we are faced with two new major problems, the first being that of engine vulnerability to damage from external sources and the second that of engine anti-icing precautions. The former will only be fully assessed after a period of airline operation, but the latter is already known to present formidable technical problems."

During the year, nine piston engines covering the entire power range were type tested and approved in the Normal Category. Two turboprop engines were type tested and approved in the Normal Category and two in the Special Category. Twelve new fixed-pitch and ten variable-pitch propellers were also approved. No radically new developments on propellers had made their appearance but a number of minor design changes, adding materially to potential safety, had been developed.

An interesting development during the year was the approval of the Inspection Organization of Air France at Orly, France, for the overhaul, repair and inspection of certain items and equipment for replacement on Viscount aircraft. This approval, which might possibly be the forerunner of others, was a logical development of the wider use of British aircraft.

The increasing use of electrical supply for vital services in aircraft had led to a re-examination of the Board's requirements for electrical power supplies, with the object of providing sufficient emergency power for continued flight and landing even if the main supply suffers complete failure. With aircraft having electrically powered flying controls this would involve duplication of the electrical power supply system. In other aircraft various emergency electrical systems were under consideration.

Referring to the Council and staff the chairman stated that on his appointment to the Council to fill the vacancy left by Sir Maurice Denny, Sir Harold Roxbee Cox ceased to act as a consultant to the Board but he remained chairman of the Engine Requirements Co-ordinating Committee. Capt. A. M. A. Majendie had been appointed to the Council to represent pilots in place of Capt. M. J. R. Alderson. A. Cdre. A. H. Wheeler, R.A.F., Retd., had accepted an invitation to act as consultant to the Board on matters affecting piloting and the flight characteristics of aircraft. With the increasing expansion of specialized activities the Board was considering the appointment of further consultants.

A.R.B. OFFICIALS

Chairman: The Rt. Hon. Lord Brabazon of Tara, P.C., G.B.E., M.C. **Vice-chairmen:** Sir Frederick Handley Page, C.B.E.; Guy F. Johnson, C.B.E.; A. B. Stewart. **Members:** A. G. Elliott, C.B.E.; Marshal of the Royal Air Force Lord Douglas of Kirtleside, G.C.B., M.C., D.F.C.; E. R. H. Hill; Captain A. G. Lamplugh, C.B.E.; Captain A. M. A. Majendie; L. Murray Stewart; J. D. North; Colonel R. L. Preston, C.B.E.; Sir Harold Roxbee Cox; J. Eric Rylands; F. E. N. St. Barbe; Whitney Straight, C.B.E.; M.C., D.F.C.; J. J. Taylor, O.B.E. (Hon. Treasurer); Major R. H. Thornton, M.C. **Chief Executive and Secretary to the Board:** R. E. Hardingham, C.M.G., O.B.E., Chief Technical Officer: W. Tye, O.B.E.

G/C. W. N. CUMMING

WITH regret we announce the death, following an illness, of G/C. William Neville Cumming, O.B.E., D.F.C., A.F.R.Ae., F.R.Met.S. He was 55 years of age. Known to his friends as "Bill," though sometimes as "Neville," G/C. Cumming had devoted most of his working life to aviation, in which his career was both active and distinguished. Between 1917 and 1926 he served first in the R.N.A.S. and then in the R.A.F., in France and India. He next went to Canada for four years, where he did much pioneer civil flying.

G/C. Cumming.

In 1931 he joined Imperial Airways, with whom he remained until 1938. During this period he was concerned with the introduction of flying-boat services, carrying out the first tests of the Short *Caledonia* from Southampton to Alexandria on March 4th, 1937. He also inaugurated the New York to Bermuda service on June 12th, 1937. It was in 1936 that he obtained his first-class navigator's ticket.

Between 1939 and 1945 he again served with the R.A.F., first in Coastal Command and later as staff officer in charge of anti-U-boat defences in the Indian Ocean. Since the war he had been associated with several air transport companies and had been director of North-West Airlines (I.O.M.), Ltd., and Southern Engineering Co., Ltd.

In 1949, G/C. Cumming served for a year as Master of the Guild of Air Pilots and Air Navigators of the British Empire. This was the year in which the Queen, as Princess Elizabeth, was installed as Grand Master of the Guild. She in turn installed the Master. G/C. Cumming was also a past chairman of the British Air Charter Association, a past-president of F.I.T.A.P., a member of the Council of the Air League of the British Empire and a member of the Helicopter Association of Great Britain.

Sympathy is extended to his widow, son and daughter.

CRANFIELD'S NEW PRINCIPAL

THE appointment of Professor A. J. Murphy, M.Sc., F.I.M., to be Principal of the College of Aeronautics, Cranfield, was announced on the occasion of the eighth annual presentation of diplomas at the College on Friday last, July 1st. Professor Murphy, who for the last five years has been Professor of Industrial Metallurgy at Birmingham University (and since 1953 Director of the department of Physical Metallurgy and Industrial Metallurgy), will take up his appointment on October 1st next.

VICKERS-ARMSTRONGS DIRECTORSHIP

AMONG the directors of the new subsidiary companies of Vickers-Armstrongs, Ltd., the formation of which was recently announced, are several who receive Board appointments for the first time. The majority of these executives are in the shipbuilding and engineering companies, but there is one in Vickers-Armstrongs (Aircraft), Ltd.—Mr. J. Anderson.

Mr. Anderson joined the Weybridge Works in April 1926. He was appointed assistant accountant in 1940 and assistant commercial manager in 1945. In April 1947 he became commercial manager, Weybridge Works, and was made a special director in 1949. In December 1950 he was appointed commercial manager of the aircraft section, with control of both Weybridge and Supermarine commercial departments.

"Flight" photograph

SYLVAN SCENE: An interlude of peace and quiet at the helicopter garden party given on June 30th by Westland Aircraft—to celebrate their 40th anniversary. The setting is the R.A.C. Country Club at Woodcote Park, Epsom, and the helicopters are two S-51s and an S-55.

HERE AND THERE

Canadian Gift for Germany

IT was made known in Bonn last week that Canada is to present three squadrons of jet fighters to West Germany "in the near future." Two squadrons will be of twin-engined fighters (presumably CF-100s) and one of single-engined fighters (presumably F-86 Sabres), to a total of 36 machines.

V.I.P. Integration

DURING Exercise Carte Blanche (reported on pp. 66-67 of this issue), Air Chief Marshal Sir Basil Embry, C-in-C. Allied Air Forces Central Europe, piloted a twin-engined communication aircraft while Marshal Juin, Commander-in-Chief Allied Forces Central Europe, acted as navigator.

Fast Last

THE F.A.I. decided that from July 1st there would be no more separate women's and men's air records; but, on the day before the new regulation came into force, Mme. Jacqueline Auriol attained 687 m.p.h. in a Mystère IVN—a speed which just exceeds the previous women's absolute speed record (held by the American, Miss Jacqueline Cochran) by the necessary one per cent. This final women's record has yet to be confirmed by the F.A.I.

Civil Helicopter Development

IT is officially stated that a contract has been placed for a gas-turbine-powered Westland S-55 which might interest civil operators. A gas-turbine version of the Bristol 173, capable of carrying up to 27 passengers, is also planned, and the Fairey Rotodyne is of such size and power as to be readily adaptable to meet B.E.A.'s 30/40-seater requirement. The Hunting Percival reactionless drive should be attractive in respect of noise reduction.

Exports Up

FIGURES for May last, recently issued, show that British aviation exports totalled £5,460,721 in value—an increase of more than £1m over the figure for May 1954.

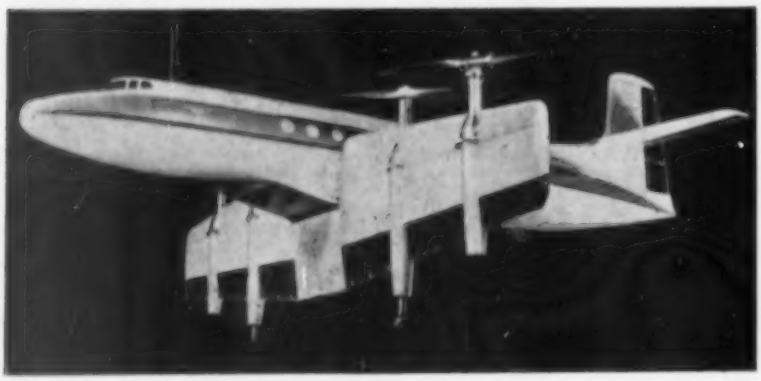
Antarctic Otters

AN order has been received by The de Havilland Aircraft of Canada from the United States Navy for four Otters. The aircraft are to be delivered this month and they will then be taken to the Antarctic on naval ice-breakers. The R.C.A.F. already use Otters for supply and rescue duties in the far north, and a large order for Otters is also being executed for the U.S. Army.

Helicopter Homecoming

THE Bristol Sycamore flown by test pilot Peter Moore (with flight engineer D. Vickery) returned to Filton on Sunday, July 3rd, from Innsbruck in the Austrian Tyrol, where it had given demonstrations that included casualty rescue from a peak 8,000ft above sea level. After appearing at the Paris Show the aircraft had flown to Stuttgart for the three-day helicopter convention there, and continued to Innsbruck *via* Munich and Rosenheim. In addition to casualty rescue, the Tyrolean demonstrations included power-line inspection and V.I.P. flights. Present at the demonstration were Mr. Raoul Hafner (Bristol chief designer, helicopters), Mr. Colin Harvie (assistant sales manager, rotating-wing aircraft), and Mr. Alex Langfield (sales demonstration engineer).

DEMONSTRATION MODEL of a vertical-take-off airliner, as shown to more than 400 of America's aviation executives who visited the N.A.C.A.'s Ames Aeronautical Laboratory, Moffett Field, on June 27th. The wings are moved to the horizontal position for normal flight.



Sicilian Air Race

WINNERS of the Seventh "Tour of Sicily" air race last month were Robert Goemans of Belgium and Fiorenza de Bernardi of Italy, flying a Piper Tri-Pacer. The race, for which there were 40 entrants, was marred by the death of Hans Ruemmedel, of Zurich, and his three passengers, when their Norecrin crashed on approaching to land at Palermo after completing a practice circuit

GOOD COMPANY: Famous pilots, a famous aeroplane. G/C. Leonard Cheshire, V.C. (left) and G/C. John Cunningham at Denham last week with the veteran Cirrus-Moth G-EBLV. The occasion was a TV broadcast, "It's Fun to Fly," which featured aircraft of the Vintage Aeroplane Club. For Cheshire, incidentally, it was the first flight in three years.

Mediterranean Record

TO be submitted as a capital-to-capital record, a flight from Ciampino, Rome, to Luqa, Malta, was made by a D.H. Sea Venom of the Royal Australian Navy last Saturday. With Lt. J. R. S. Overbury, R.N., as pilot and Lt-Cdr. G. Kable, R.A.N., as navigator, it covered the 422 statute miles at a (provisional) speed of 538 m.p.h. Another Sea Venom accompanied the record-breaking aircraft.

Towards Mach 18

THE associate director of the N.A.C.A. laboratory, Mr. J. F. Parsons, has told a Press conference that "tiny" model aircraft will be fired at speeds from Mach 9 to Mach 18 at Moffett Field, California. The tests will be made in a pressurized tank, so that all altitudes can be simulated and models as small as ¼in long would be employed. The investigations were described as part of research into problems that will arise when man achieves hypersonic travel and space flight.

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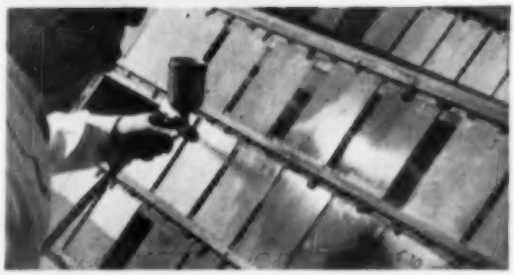

Test panels receiving salt spray treatment.

Recorder for temperature and humidity.

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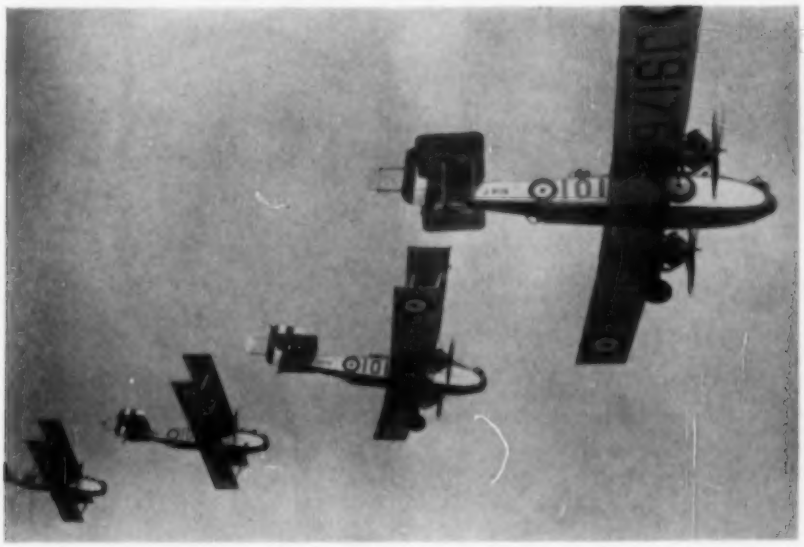


Sidestrand III day bombers in service with No. 101 Squadron, R.A.F.—a "Flight" photograph of 1933.

BOBOLINK TO DELTA

BOULTON PAUL AIRCRAFT OF FORTY YEARS

By H. F. KING, M.B.E., and "B.P." Test Pilots

Part I GROWTH OF A COMPANY

THE great structural-engineering company of Boulton and Paul, founded in the year 1797, acquired a new interest in 1915, when the Air Board enlisted its services for the production of standard fighting aircraft, of which the F.E.2B was the first. The company was well equipped for the high-class woodwork demanded, and its engineering department included a small foundry.

Construction began at the Rose Lane, Norwich, works, the facilities of which were extended in 1916 by the opening of a new self-contained factory at Riverside, Norwich, having its own railway sidings and river frontage, and access by road to an aerodrome some two miles distant. There erection shops were set up, together with facilities for test flying prior to the handing over of machines to the Royal Flying Corps. The F.E.2Bs were followed by F.E.2Ds, and orders were met for great quantities of propellers of many types.

The first aircraft built by Boulton and Paul, an F.E.2B.

At Riverside there was a sizeable experimental and research department, equipped with mechanical testing machines of the latest pattern, with chemical, metallurgical and photographic laboratories, and a wind tunnel of the 4ft N.P.L. type. With this backing, in 1917, the company decided to embark upon aircraft designs of its own, and engaged Mr. John D. North as chief engineer. Mr. North had been successively a pupil of the Aeronautical Syndicate, chief engineer to the Grahame White Aircraft Co., Ltd., and superintendent of the aviation department of the Austin Motor Co. Upon joining Boulton and Paul he put in hand the designs for the Bobolink single-seat fighter and the Bourges twin-engined day bomber. Following the F.E.2D, the company turned out Sopwith Camels and Snipes, and built also a number of hulls for the F.3 and F.5 flying boats. At the peak of production, in 1918, the output of Camels exceeded 45 a week.

As the war neared its end the supplies of high-grade spruce for aircraft construction were dwindling alarmingly and inferior timbers were being employed to an increasing degree. The requirement thus arose for a wider use of metal construction, and Boulton and Paul turned to high-tensile steel as a structural medium demanding no penalty of weight. By the end of 1918 a form of steel spar had been developed upon which a subsequent standard system of metal construction was based. So promising was the new material that in 1919 the company resolved to abandon timber entirely, though this could not be wholly implemented for several years. Timely decision, however, did enable the firm to take a leading place among aircraft constructors.

Through unpropitious times, with wartime contracts terminated, and in the likelihood that a working loss must be accepted until more stable conditions arrived, the experimental aircraft department was kept in being. Certainly there was no lack of enterprise or imagination. The Atlantic machine, later described, was remarkable in every way and demonstrated an extremely high performance, while of the little P.9 two-seater the phrase "ahead of its time" could be applied with conviction.

BOBOLINK TO DELTA . . .

The P.10 as exhibited at the Paris Salon of 1919 was Boulton and Paul's first "all-metal" aeroplane—a description which must be qualified, however, with the remark that plastics were used for the covering of the rear fuselage! In this design, also, was incorporated the first swinging engine-mounting, a feature which was to be reproduced in a number of B.P. designs thereafter.

As the development of metal construction went ahead, the aerodynamic staff were concerned with the progressive improvement of twin-engined bomber design, the measure of which is apparent in the photographs on pages 45-47. In the wind tunnel they investigated the properties of various combinations of wing, body and engine-nacelle in order to minimize interference effects, and the fruit of their labours was the Sidestrand, of 1927, which achieved a performance, in terms of speed, climb and ceiling, comparable with the best single-engined bombers of the day. Such were the circumstances of the times, however, that only a single R.A.F. squadron—No. 101—was ever equipped with these fine machines.

Historical notes for which we are indebted to Mr. W. J. Pickthorn, remark that a notable contribution to the success of Boulton and Paul metal construction, and one which was patented by the company itself, was the continuous heat-treatment process, by which formed sections were drawn through electric furnaces, mounted on drawbenches, at speeds slow enough to enable the strip to soak at the appropriate temperatures. Rapid quenching for hardening was achieved by the use of water-cooled dies at the furnace exit. Formerly steel strip had been delivered from the makers hardened and tempered, and had been rolled or drawn in this state. This meant that, apart from the difficulty of forming, it was impossible to obtain uniformity of heat treatment throughout, and local variations in ductility caused distortion of sections in passing through the dies or rollers. The distortion had to be rectified by subsequent straightening operations which were delicate and costly.

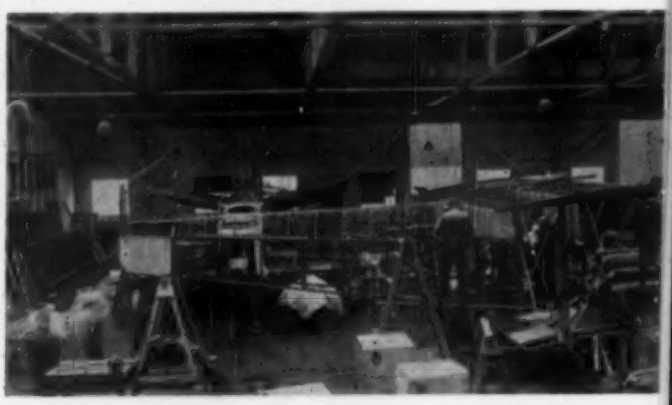
All these difficulties were solved by the new process, for the strip was formed in the soft state and was held straight throughout its heat treatment—itself controlled within very narrow limits to ensure uniformity.

Another of the company's inventions was the "locked-joint" tube, wherein strip was drawn to circular, or other tubular, sections, a bead being formed along one edge of the strip, around which the other edge was wrapped inside the tube. By this means tubular members could be produced in stainless steels and in other difficult materials which, at the time, could not be worked by the "solid-drawn" process. Moreover, some saving in weight resulted, since the limits of thickness in rolling strip were much finer than the limits of eccentricity specified for solid-drawn tubes. Thus, it was frequently possible to use locked-joint tubing in a lighter-gauge material than for its solid-drawn equivalent. The same means was extended to the uniting of two strips by means of locked joints at both edges, to form spars of figure-eight section, streamline struts and other shapes.

The company look back also with justifiable pride on the very large measure of standardization achieved with their metal sections. Box-type wing spars, for example, were made with a range of three standard web-section forms and six flange-section forms, providing eighteen basic spar shapes, each of which could be produced in strips of various thicknesses to cover a total range of some 2,000 spars, suitable for use in aircraft ranging in gross weight from 2,000 lb to 20,000 lb. Similarly standardized were struts, longerons and other members, and the system was applied successfully not only to the firm's own designs but also to such notable aircraft as the Blackburn Bluebird, B.2 Trainer, Ripon and Shark, and to the Saunders-Roe London flying boat.

The tendency in the later stages of development was to use high-tensile steels for the main structural members (wing spars, interplane struts, drag struts, longerons and the more heavily loaded struts in the front fuselage) and light-alloy for the secondary components such as ribs, leading and trailing edges, lightly loaded struts and fairing members. An exception was the all-steel system of light-aircraft construction developed for the Phoenix lightplane and widely used on the Blackburn B.2, wherein, instead of the normal riveting, spot-welding was employed, resulting in a very cheap and efficient method of manufacture.

The company's experience in metal construction, and particularly in the handling of stainless steels, was undoubtedly a deciding factor in its selection, in 1927, to collaborate with the Royal Airship Works in the design and construction of H.M. Airship R.101. Of five million cubic feet capacity, the R.101 was very much larger than any previous dirigible but departed

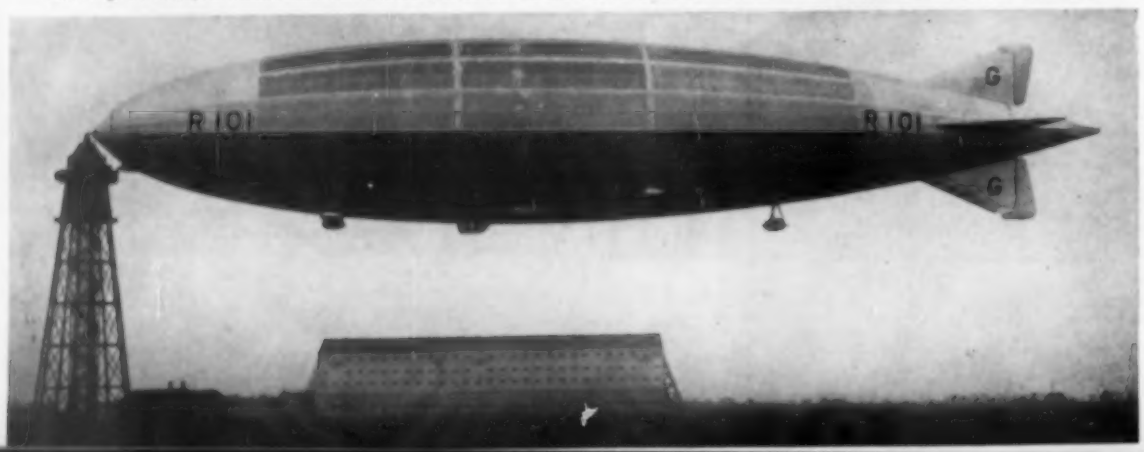


The Atlantic under construction, with the Bourges la in the background.

entirely from former practice in that steel was used for the main structural members of the frame instead of Duralumin. The detail design and manufacture of the entire main hull structure was carried out by Boulton and Paul, and Mr. North (by that time a director of the company) acted during this period as consultant to the Director of Airship Development. The great size of the ship and the multiplicity of frame members obliged the Boulton and Paul engineers to go to extraordinary lengths in the calculation of sizes of individual members to avoid cumulative errors and in the accurate setting of assembly jigs to suit. So meticulously was this pursued that, when the frame was erected at Cardington, every component went into place without the slightest hitch. The tragic loss of the great airship was in no way a reflection on its structural design or manufacture.

In the late 1920s also, by agreement with Dr. H. C. H. Townend and the Department of Scientific and Industrial Research, the company undertook the administrative and commercial exploitation of the Townend ring patents. Numerous forms of the ring—many of them combined with exhaust collector—were evolved and were widely employed, and patents were obtained and exploited in many countries. Experiments with the ring were made in numerous aircraft, including the company's Sidestrand bomber, a machine of notable efficiency in respect of design, construction and military effectiveness. As performance of the Sidestrand was progressively improved, so the difficulty of manning its guns became more pronounced. The company's answer to this problem, in respect of the front gunner, at least, was a power-driven turret, as applied to the Overstrand and later described. The success of this turret (and, the makers remark, the publicity it received) led to the acquisition, early in 1935, of the British rights for the de Boysson turret from the Société d'Applications des Machines Motrices, and this design formed the basis of subsequent Boulton Paul turrets. In his book *I Hold My Aim*, G/C. C. H. Keith remarks: "I think very great credit is due to North for his enterprise. In this and many other

The dirigible R.101, the entire main hull structure of which was the work of Boulton and Paul. The airship is seen moored at Cardington.



H.R.H. the Prince of Wales with a Sidestrand III at Norwich in 1933.

For comparison with the previous picture the turreted nose of the Overstrand is shown in close-up.

intricate armament problems we put to him, he always showed a ready inclination to co-operate and undertake special development work in the Boulton and Paul workshops. He was one of the first to realize that an aircraft, no matter how good it might be, was of no use in the R.A.F. unless it was capable of carrying good armament equipment. He suffered many disappointments and I rather doubt whether he received the recognition that was his due."

As from June 30th, 1934, the aircraft business and interests of Boulton and Paul, Ltd., were taken over as a going concern by a newly formed public company—Boulton Paul Aircraft, Ltd.

During the following year, when the Royal Air Force expansion scheme was initiated, the company was engaged in establishing a new factory at Wolverhampton, and was temporarily carrying on in leased premises in Norwich, finishing off the Overstrand contract and tooling up for much larger production of Hawker Demon two-seat fighters. During August 1936 the transfer of plant and work to Wolverhampton was accomplished and most of the Demons were delivered from the new factory. In deciding upon the move the company was influenced by Wolverhampton's high tradition as a centre of engineering, and by the availability of skilled labour. Even so, expansion was so rapid that labour-supply was soon to become a serious problem, and districts as far afield as Clydeside and Northern Ireland were combed for additional staff.

When war came it was necessary to train large numbers of unskilled workers from other industries, and dispersal premises at Cannock were therefore acquired and converted into a school. A number of branch factories and stores were established in and around Wolverhampton, and the main factory was twice extended, until it covered almost three times its original area.

The Hawker Demons were followed by Blackburn Roc carrier-borne turret fighters and by Boulton Paul's own magnificent fighter—likewise armed with a B.P. four-gun turret—the Defiant. Of Rocs, 105 were built; of Defiants, 1,060. The equivalent of 395 aircraft was supplied as Roc and Defiant spares.

While other factories were being equipped for the production of Boulton Paul turrets, the Wolverhampton works carried on with the production of these highly successful devices. Many varieties were developed for 0.303in, 0.5in and 20 mm guns, and for the nose, tail, mid-upper and mid-under positions. Aircraft equipped, apart from the Roc and Defiant, included the Hudson, Ventura, Baltimore, Halifax, Liberator, Albemarle and Lincoln, and installations were also made on the Short "C" and "G" class flying-boats and on the Seaford. Special versions of the 0.303in four-gun turret were adapted for use in mine-sweeping flotilla boats. The company built 1,597 of its own turrets and 207 sets of special turret equipment for training and test purposes. Many thousands of the turrets were made by other contractors.

The last war-time contract for aircraft involved production of Fairey Barracudas of which 692 were completed.

With the coming of peace the pressure of armament development was relaxed, and the technical staff once again turned their attention to aircraft. The first post-war machine was the Balliol advanced trainer, the development of which is later described, and which serves today as standard equipment in the Royal Air Force and Royal Navy, and in the Royal Ceylon Air Force. While the Balliol was under development the company was engaged on the conversion of Vickers Wellington bombers for use by Training Command. There was activity, also, in the development of power-operated controls and on a wide variety of research work in the electronic, aerodynamic and physical fields. In 1950 the P.111 tailless delta-wing research aircraft was completed, and was quite extensively flown during 1951 and 1952. A variant of this machine, the P.120, appeared in 1952 and was flown for many hours by the company's chief test pilot, A. E. Gunn, until it met with the accident later described by Gunn himself. Meanwhile, the P.111 was returned to Wolverhampton for modification, and as the P.111A is still flying today at the R.A.E., Farnborough.

Boulton Paul Type E Mk 1 turret in the tail of a Halifax.

The first Boulton Paul power controls were designed for the company's own deltas, and were followed by units for the Saunders-Roe Princess and for advanced military machines.

At the recent annual general meeting of Boulton Paul Aircraft, Ltd., the chairman, Mr. J. D. North, said that conditions of official secrecy made it difficult to be more specific, but it could be said that already a large majority of the heavy bombers for the R.A.F. were using Boulton Paul power-control systems.

Blackburn Roc turret fighters built by Boulton Paul.

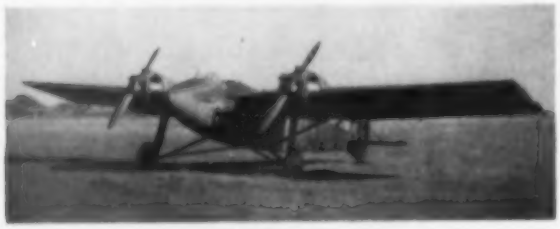
Defiant turret fighters awaiting delivery from Wolverhampton.

BOBOLINK TO DELTA . . . **Part II**

THE B.P. LINE

P.3 Bobolink.

P.33 Partridge.



P.31 Bittern.

P.82 Defiant I (prototype).

Above, P.82 Defiant I (production); below, P.82 Defiant T.T.1.

FIGHTERS

P.3 Bobolink Originally called the Hawk (until renamed in conformity with an official system of nomenclature), the Bobolink* was the first aircraft built to Boulton and Paul designs. A competitor of the Sopwith Snipe, it was powered, like its rival, with a Bentley B.R.2 rotary engine of 230 h.p. Another point of similarity was the two-bay wing cellule, though a distinction of the Bobolink was the use of interplane struts of N formation. Twin synchronized Vickers guns, having C.C. gear to allow them to fire through the airscrew arc, were mounted forward of the cockpit. Measuring 29ft in span, the Bobolink had a wing area of 266 sq ft, weighed 1,220 lb empty and 1,920 lb all-up. Fuel capacity was 38 gallons, giving an endurance of over 2½ hours. At 10,000ft a maximum speed of 125 m.p.h. was achieved, and at 15,000ft, 110 m.p.h. The climb to 10,000ft took 9½ min and to 15,000ft 18 min. Landing speed was 50 m.p.h.

P.33 Partridge The Partridge was built in 1927/28 for the competition which was eventually won by the Bristol Bulldog, and it appeared in the New Types Park at the R.A.F. Display of 1928. A remarkable feature was its metal structure, which was largely made up of components already standardized for the Sidestrand bomber, thus rendering production cheap and rapid. In common with the Sidestrand also, the Partridge had square-cut wing and tail surfaces—features which contrasted with the well faired fuselage, bulged amidships to house the two Vickers guns. Upper and lower wings were built in two sections, the upper ones being joined on the centre-line. Originally ailerons were fitted to the top wing only, but eventually were added on the lower wings also, upper and lower surfaces being interconnected by struts. The spars had corrugated flanges and webs, and tubular and plate stiffeners and the fuselage consisted of a rectangular frame in two parts. The front part carried the engine mounting, tanks, wing attachments and pilot's seat, and was built from solid-drawn high-tensile steel tubes, and the after part had Boulton and Paul "locked joint" tube longerons with steel and Duralumin struts. The bay containing the cockpit had top longerons of large-diameter solid-drawn tubes which supported the two Vickers guns without additional structure, and, by reason of their great strength, served to ensure that this section of the structure should not telescope in a crash. Though a Bristol Mercury engine had been intended, the power unit actually fitted was a Jupiter VII, mounted on a flanged ring plate of steel. The petrol tank was unusual in being of dual type, i.e., consisting of a main tank having within it an inner tank serving both as a service tank and as a baffle.

Partridge data were: Span 35ft, wing area 311 sq ft, weight empty 2,021 lb, fuel 471 lb, oil 55 lb, military load (including pilot) 550 lb, gross weight, 3,097 lb, wing loading 9.9 lb/sq ft, power loading 7.35 lb/h.p., maximum speed at 10,000ft 167 m.p.h., climb to 10,000ft 6.5 min, climb to 20,000ft 15.06 min, service ceiling 28,950ft, landing speed 61 m.p.h.

P.31 Bittern The Bittern (1928) was one of the most remarkable fighters of its day, being a single-seat, twin-engined monoplane night fighter with unorthodox armament. The wing was mounted shoulder-high and the pilot was seated ahead of it, in an open cockpit. He was to be provided with a special moving sight, interconnected with two 0.303in Vickers guns mounted on the sides of the fuselage in special cradles, which would allow the guns to be elevated. Thus attack would be possible from positions denied to fixed-gun fighters.

There were two Bitterns, numbered J7936 and J7937. The first had its Lynx engines mounted with their centre-lines approximately on the chordline of the wing. The engines were un-

* *A common American songbird.*

P.92 (flying scale model).

P.82 Defiant II

cowled and the wing was a pure cantilever structure with square-cut tips. In the second machine the thrust lines of the engines were lowered; Townend ring cowlings were fitted; the wing was strut-braced; the wing-tip shape was revised; and Handley Page slots were fitted. Though the fitting of the Townend rings increased the speed by 7 m.p.h., performance remained inadequate, which is not surprising in view of the relatively large size and weight of the Bittern (span 41ft, gross weight 4,500 lb) and the low power of the Lynx engine (214 h.p.).

P.82 Defiant I Air Ministry Specification F.9/35 called for a turret fighter—that is, a fighter wherein the entire armament would be concentrated in a power-operated turret—and to its requirements Boulton Paul produced a machine of exceptional qualities, named Defiant. The first prototype, K8310, was initially flown on August 11th, 1937, and at the end of the year the type passed into production with the Rolls-Royce Merlin III, with which powerplant 713 machines of the type were eventually built for the R.A.F.

The Defiant wing was made in five main sections—the centre-section, two outer panels, and detachable tip portions—and embodied two main spars, having top and bottom booms of extruded light alloy, and light-alloy sheet webs with vertical corrugations. The flush-riveted stressed skin had Z-section stiffeners riveted on. Frise-type ailerons were fitted on the outer panels, and there were hydraulically operated split trailing-edge flaps between the ailerons and fuselage. The fuselage itself was of oval-section and built in two main portions; the first of these was built up of four L-section longerons and a number of massive bulkheads, and the rear part was made up of three units—two side members and a deck. Surmounting the deck, fore and aft of the turret, were light fairings which hinged downwards automatically, under the action of pneumatic jacks, to permit the turret to be traversed.

The Boulton Paul turret, a removable, self-contained unit, mounted four 0.303in Browning guns, and the whole of its hydraulic system was part of the turret itself, having no connection with any other hydraulic system in the aircraft. The Merlin III engine, rated at 1,030 h.p. at 16,500ft, drove a de Havilland constant-speed three-blade airscrew of 11ft 6in diameter, and was supplied with fuel from two tanks in the outboard extremities of the centre-section.

The Defiant proved an excellent flying machine and won golden praise from the Aeroplane and Armament Experimental Establishment. Span was 39ft 4in, length 35ft 4in, wing area 250 sq ft, weight empty 6,078 lb, normal flying weight 8,318 lb, max. permissible loaded weight (night fighter) 8,600 lb, speed at 17,000ft 304 m.p.h.

P.82 Defiant II In this sub-type the Merlin XX engine, delivering 1,260 h.p. at 12,250ft, was substituted for the Merlin III. The engine mounting was redesigned, as were the radiator and cowling, and additional fuel tankage was provided. Other modifications were the fitting of a slightly larger rudder and a pressurized fuel system. Deliveries began early in 1941 and continued until January of the following year, when production ceased with the 207th aircraft.

P.82 Defiant T.T.1 A target-tug version of the Defiant II, with the same engine. One hundred and forty were built "from scratch," and many Defiant II fighters were converted to the same standard.

P.82 Defiant T.T.3 This designation distinguished the target-tug conversion of the Defiant I (Merlin III). Many of the type were "tropicalized" for service with the Royal Navy overseas.

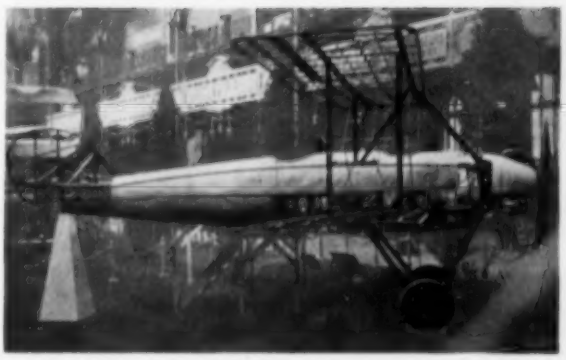
P.92 In 1939 Boulton Paul projected another turret fighter, of very advanced concept. It was to be powered with two Rolls-Royce Vulture engines, would weigh over 19,000 lb, and be capable of over 370 m.p.h. at 15,000ft. The armament of four 20 mm guns was to be concentrated in a massive low-drag dorsal turret, the cupola of which merged into the high-mounted wing. A crew of three—pilot, navigator and gunner—was to be carried, and range with auxiliary tankage would be 2,000 miles. Although the full-scale aircraft was never built, a half-scale model, with two de Havilland Gipsy Major engines, was constructed by Heston Aircraft, Ltd., and was extensively flown.

LIGHTPLANES

P.6 A little single-bay biplane, built in 1918, the P.6 two-seater was used for full-scale aerodynamic research and was powered with a 90 h.p. RAF. 1A engine. Judicious application of the results of tests with this type, and in the wind tunnel, contributed largely to the aerodynamic advances which characterized the company's later machines; and the inscription "Boulton and Paul, Ltd., Sales Department," painted prominently beneath the wings and on the fuselage sides (see photograph on this page) proclaimed the incidental usefulness of the machine as a

P.6.

P.9.



Above, P.10; below, P.41 Phoenix.

P.8 Atlantic.

P.12 Bodmin.

P.64 Mail Carrier.

P.71A feeder-line aircraft.

BOBOLINK TO DELTA . . .

"runabout." Measuring 25ft in span and 19ft in length, the P.6 achieved 103 m.p.h. at 1,000ft and landed at 45 m.p.h. Gross loaded weight was 1,725 lb.

P.9 This machine followed the P.6, in 1919, and was generally similar, except that the span was increased to 27ft 6in and the length to 24ft 8in. Two P.9s were entered in the 1922 King's Cup Race round Britain. Both acquitted themselves well. On a later page S/L. Rea tells of his successes in a P.9 at the 1927 Bournemouth meeting. Construction was orthodox (wood), but the excellence of the aerodynamic design was reflected in a performance which compared well with that of the de Havilland Moth of later years. The full load speed at 1,000ft was 104 m.p.h. and the climb to 5,000ft took 8½ minutes. Ceiling was 14,000ft and range, at full throttle, 3 hours. Empty and gross weights were, respectively, 1,244 lb and 1,770 lb. Several P.9s were sold (at £300 apiece) and a number of them were used in Australia and elsewhere. The original machine made the first air crossing of the Bass Strait to Tasmania. At least two examples were flying as late as 1929.

P.10 Though following the P.9 in layout, the P.10 was completely unorthodox in construction. It first appeared at the Paris Show of 1919, and *Flight's* technical editor then wrote of it: "... the Boulton and Paul all-metal machine, P.10, is the machine of the show, from a constructional point of view. Mr. J. D. North, aided by a very able staff of assistants, has here produced something which marks a very real step forward in aeroplane construction. Personally we have always been believers in metal construction for aircraft, but we admit that until now we had scarcely thought the time ripe yet for its introduction. After seeing the P.10 and discussing it with Mr. North, we are inclined to think that the time is already here when metal construction, if scientifically carried out, is not only possible as a substitute for wood, but is even superior in many respects. For instance, the weight of the P.10 actually comes out lighter than the same machine built in wood in the ordinary way, while its strength is, if anything, superior to that of the wood machine. This, however, is not the chief point of the design, although it incidentally proves to what state of perfection Boulton and Paul have carried metal construction. The chief advantage will probably be found in the longer life of the steel structure."

Even more remarkable than the Boulton and Paul metal work was the use of plastics (this in 1919), the rear fuselage of the P.10 being a monocoque built up of Bakelite Dilecto sheets held between high-tensile steel formers and stringers. Yet another novelty was the swinging mounting—the first of its kind—which gave ready access to the rear of the Cosmos Lucifer three-cylinder radial engine without disturbing the control runs.

The span of the P.10 was 30ft and all-up weight 1,750 lb.

P.41 Phoenix The first experimental version of this two-seat light monoplane was shown at Olympia in 1929. Powered with a 40 h.p. A.B.C. Scorpion engine, it was, in reality, what would now be called an aerodynamic test vehicle, and differed very much in structure from the second edition, which was intended as a production model, and was powered with a 40 h.p. Salmson nine-cylinder radial. The all-steel system of construction developed for the Phoenix (wherein the normal riveting was replaced throughout by spot welding, resulting in a very effective and cheap method of manufacture) was later widely used on the Blackburn B.2 trainer. A point of unusual interest was that the rudder was identical, and interchangeable, with each half of the elevator. The span was 30ft and the normal all-up weight 1,000 lb.

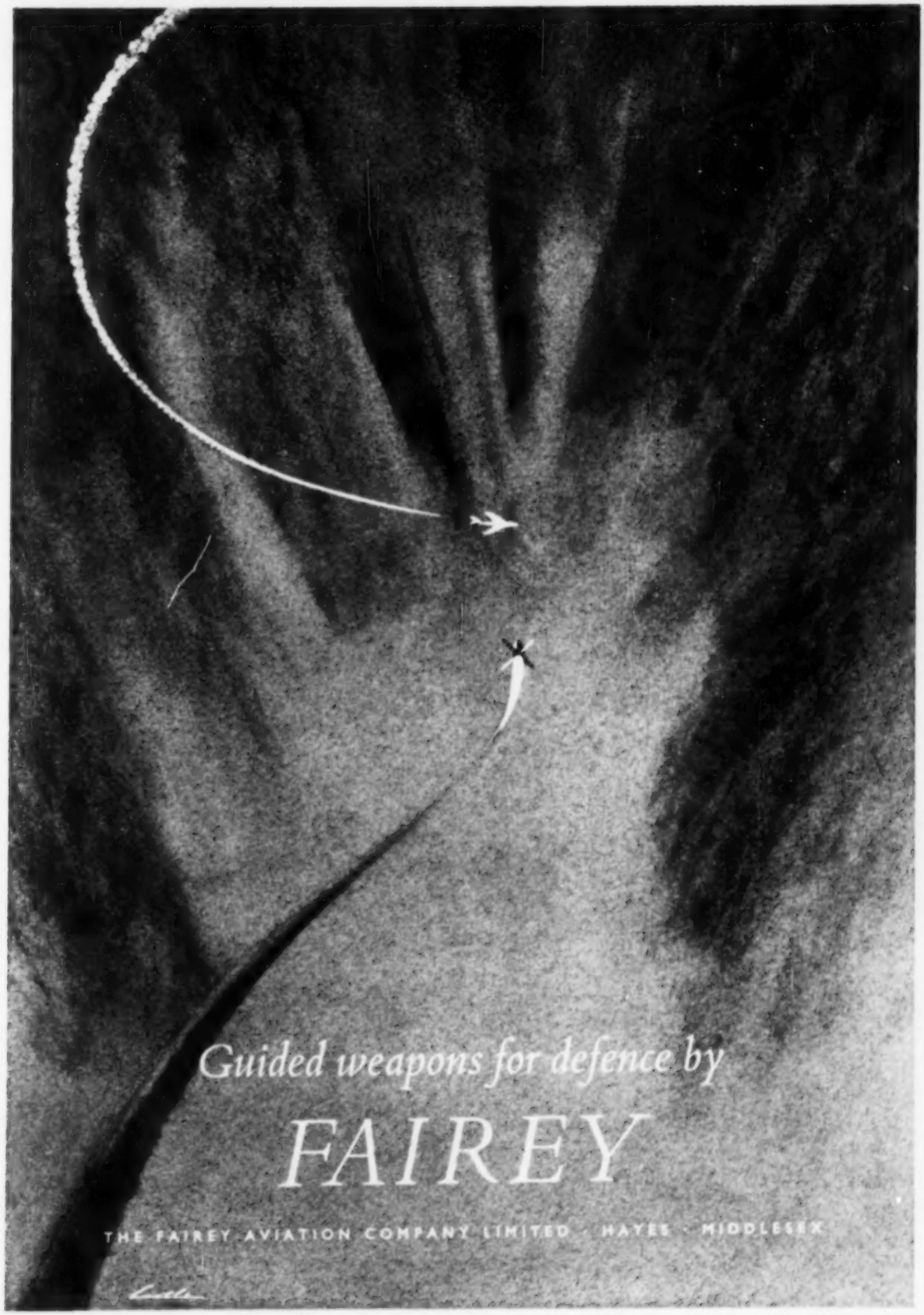
TRANSPORTS

P.8 Atlantic For the great transatlantic contest of 1919 Boulton and Paul prepared a long-range civil version of the Bourges under the foregoing designation, and of this *Flight* wrote in May of that year: "One of the most important features of the Boulton and Paul machine is that after a short time in the air (about two hours for the amount of fuel carried for the transatlantic flight) the machine is able to keep aloft on one engine only. The importance of this can scarcely be exaggerated. It will mean, looking at it in another way, that after two hours the two Napier engines need only be run at half their power. This should mean an enormous increase in their chance to 'stick it' for the whole journey. It is further to be noted that the 'cruising speed' of the machine is as high as 116 m.p.h. This is probably the highest cruising speed of any machine entered so far for the race. When flying at the cruising speed the range of the Boulton and Paul machine has been calculated to be about 3,850 miles, so that there is an ample margin in hand for the transatlantic journey."

Fuel was carried in six tanks, each fitted with jettison valves operated by a lock control in the cockpit. These valves could discharge the whole of the fuel in 1¼ minutes, and the tanks were so situated that when empty they would keep the machine afloat and right-way-up. A crew of three was intended for the Atlantic crossing, a first pilot (Major K. S. Savory), second pilot and wireless operator (Capt. A. L. Howarth), and navigator (Capt. J. H. Woolner). *Flight* added: "Two independent wireless sets will be fitted, a 'spark' wireless for sending and receiving messages, and a 'directional' for navigation purposes. A small hydrogen bottle and a balloon will be carried so as to make it possible to send up an 'aerial' for sending wireless 'S.O.S.' even after the machine is on the sea . . ."

After several months had been spent in studying meteorological conditions over the North Atlantic and in perfecting navigational arrangements, an advance party, headed by Major Guy Ffiske, visited Newfound'and to select a suitable site for take-off. Alas, all these preparations were nullified by an accident on the first flight. The P.8 had just left the ground when one of the Napier Lion engines cut out and the aircraft slewed round side-to-wind. A wing-tip touched the ground, and the aircraft was wrecked. A duplicate was under construction but before this could be prepared for the Atlantic crossing Sir John Alcock and Sir Arthur Whitten Brown had conquered the Atlantic in the Vickers Vimy, and further arrangements were abandoned. The second machine was completed and used for a considerable period on full-scale aerodynamic research work. Span was 61ft, length 40ft, and loaded weight about 7,000 lb. Estimated top speed at 10,000ft was 149 m.p.h.

P.12 Bodmin The Bodmin was described by the Air Ministry as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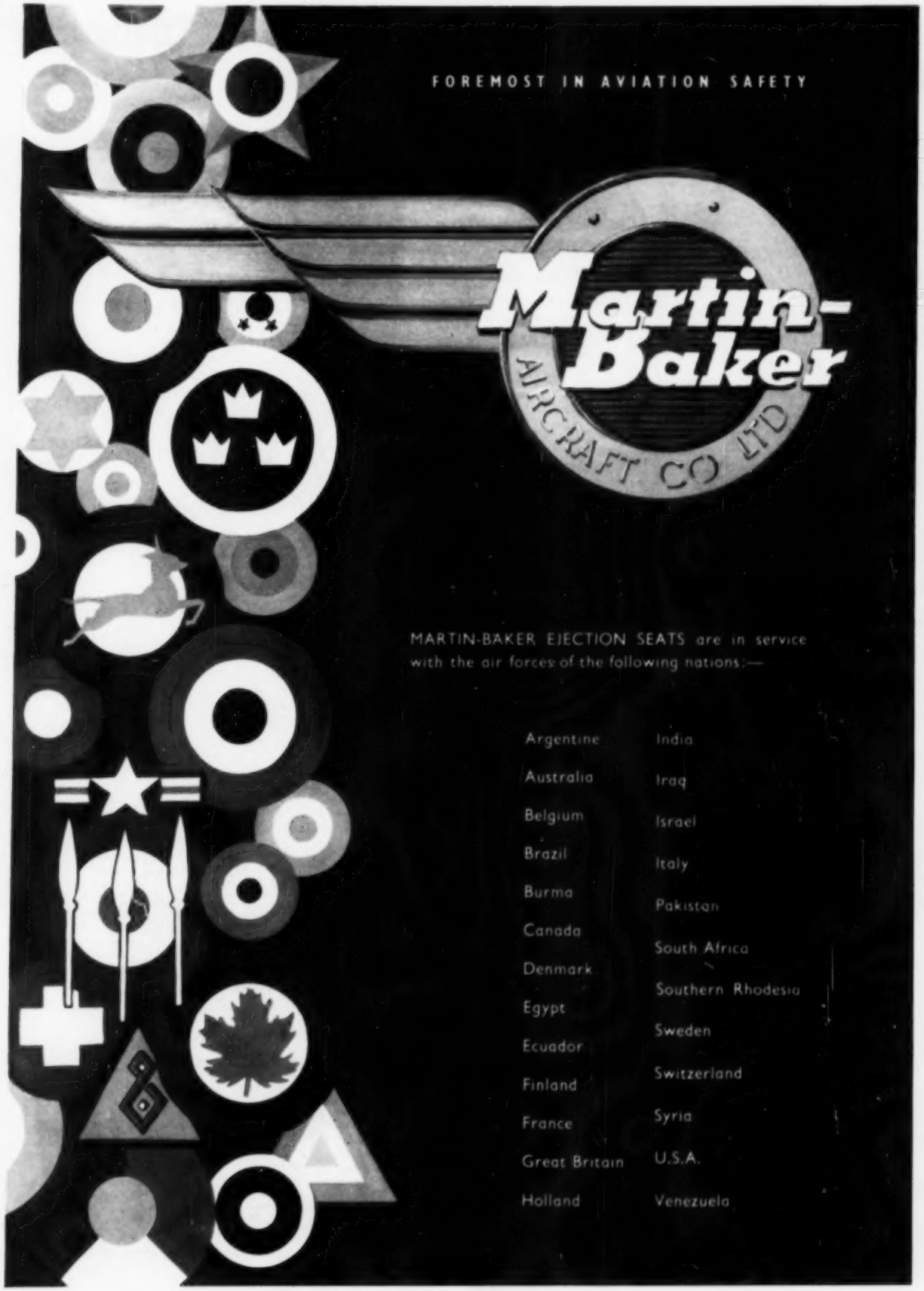
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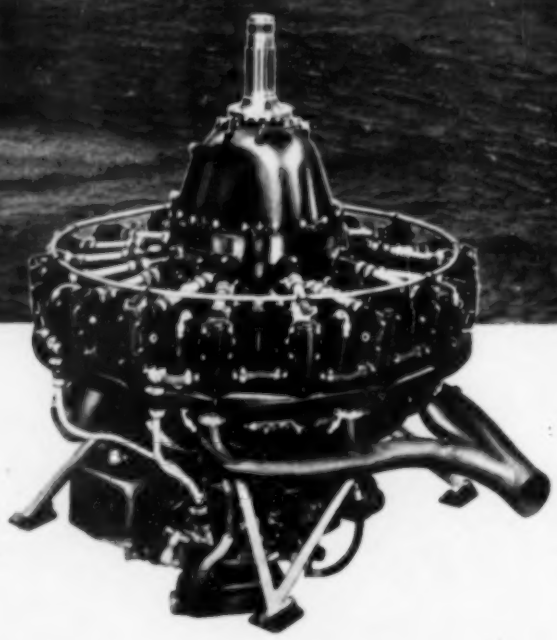
Dependable Engines



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P.7 Bourges I (Bentley B.R.2 engines).

BOBOLINK TO DELTA . . .

a three-seat, medium-range, postal aircraft, but was in reality an experimental military prototype for investigating the possibilities of fuselage-mounted engines. When *Flight* described the machine, in September 1923, it was remarked that the main object aimed at was reliability—not merely reasonably good reliability, but the nearest approach to absolute reliability which it was humanly possible to provide. Consequently, the whole powerplant installation was planned with this object in view, and other considerations, such as extra-long range and great carrying capacity, took second place. "It will readily be understood," ran our account, "that, however the problem is attacked, a machine with central engines and propellers on the wings must of necessity be heavier than one in which the engines are placed on the wings. Not only is there the extra weight of the transmission gear, but the fact that the engines are centrally placed increases the load on the wings, which, therefore, have to be built stronger, i.e., heavier, than in the ordinary twin-engined biplane with the engines on the wings. When, therefore, Boulton and Pauls have succeeded in building a machine of this type, in which there is still a reasonably large proportion of useful load, this is an achievement which has been rendered possible mainly by virtue of the all-metal construction."

The main structural members were of high-tensile sheet steel, rolled, drawn or stamped to the required section. In many parts the more usual drawn steel tubes were replaced by circular-section members manufactured from the flat sheet by Boulton and Paul patented processes. These processes allowed the tubes to have much thinner walls than could be produced in the ordinary way, with the result that, as the material was high-tensile steel, a great weight reduction could be effected.

The two Napier Lion engines were placed in, or more strictly on, the fuselage, and drove two tractor airscrews and two pusher propellers. An engineer could walk along the fuselage to attend to the engines and could stand upright between them. The "engine room" was lit by windows and electric lights. There were six separate petrol tanks, so arranged that any one could be shut off should it be holed or damaged in any way. The radiators, moreover, were in six separate sections, any or all of which could be shut off so as to reduce the amount of water lost owing to a leak or puncture. *Flight's* observer was much impressed. At first sight, he reported, it seemed impossible that one man could look after all the rev counters, thermometers, oil pressure gauges, taps, etc.; but he conceded that, after an engineer had once become familiar with the various items, he should have no difficulty in keeping an eye on everything.

Air tests showed that the Bodmin was able to fly level on the power of only one of the Lions, and in this respect it scored over conventional "twins" in that, whether one or two engines were running, the thrust was always central, as the front engine drove the two tractor screws and the rear engine the two pushers. Moreover, the airscrews were "handed." The main wheels had oleo-pneumatic shock-absorption with an 18in travel, and a pair of smaller wheels was mounted forward to guard against nosing over.

Two Bodmins were built, numbered J6910 and J6911. Span was 70ft, length 53ft 4½in, wing area 1,204 sq ft, weight empty 7,920 lb, gross weight 11,000 lb, speed at ground level 116 m.p.h., climb to 6,500ft 8.9 min, service ceiling 16,000ft.

P.64 Mail Carrier The Mail Carrier was a very clean, twin-engined biplane, built in 1933 to meet an Air Ministry requirement for a high-speed machine capable of carrying 1,000 lb of mail for 1,000 miles non-stop at 150 m.p.h. This performance was to be achieved on approximately half the maximum horse-power, and single-engined flight was to be possible with the remaining engine running at less than its normal r.p.m. The two Bristol Pegasus 1M2 geared and supercharged radial engines had Boulton and Paul nonagonal Townend rings with leading-edge exhaust collectors, and fuel was carried in five tanks—four main tanks of 74 gallons each in the outer wing panels, and a collector tank of 29 gallons in the starboard centre-section. The fixed main undercarriage was comprised in two streamline units, faired with plywood, a material which was also used for the extreme nose section of the fuselage. The main structure was, however, of metal, employing standard Boulton and Paul sections. High-tensile steel was used for the more highly stressed members and light alloy for the other parts. The pilot's cockpit was totally enclosed and had dual control, and there was a separate navigating compartment forward of the mail compartment, which was accessible to the crew in flight. On completion, during the spring of 1933, the Mail Carrier made a few test flights before it came to grief on the ground, as later described by its pilot, S/L. Rea. By June, however, it was flying again.

P.7 Bourges I (A.B.C. Dragonfly engines).

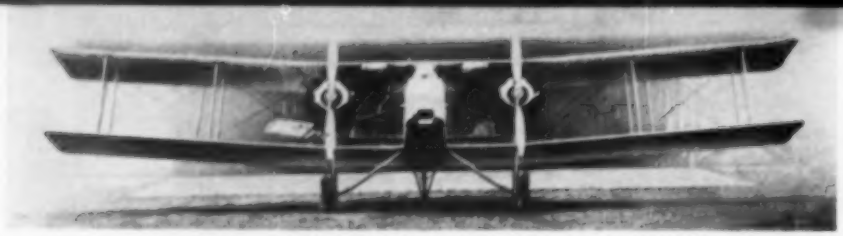
P.7a Bourges Ia.

P.7b Bourges II.

P.15 Bolton.

Span was 54ft, length 42ft 6in, empty weight about 7,000 lb and all-up weight 11,267 lb. Top speed was of the order of 185 m.p.h. at 5,000ft, and cruising speed 160 m.p.h. Even at 5,000ft the rate of climb was still 1,200ft/min.

P.71A To the order of Imperial Airways, in 1934, Boulton and Paul produced two special developments of the Mail Carrier, powered with Armstrong Siddeley Jaguar VIA engines from the airline's own stock. Other noticeable differences were the swept-back mainplanes, with rounded tips, and the revised tail unit, with triple vertical surfaces. The two machines were named *Britomart* and *Boadicea*, and were fitted out to carry six or seven



P.25 Bugle I.

P.25a Bugle II

P.29 Sidestrand I (prototype).

P.29a Sidestrand II.

BOBOLINK TO DELTA . . .

passengers in more than usual comfort. The centre portion of the fuselage differed from that of the Mail Carrier in being formed of built-up channel-section Duralumin girders over which was riveted a corrugated Alclad sheet covering.

The P.71A measured 54ft in span, was 44ft 2in long, and had a wing area of 1,718.5 sq ft. Empty and maximum permissible weights were 6,100 lb and 9,500 lb respectively, cruising speed was 150 m.p.h. at 4,500ft, take-off run (no wind, full load) 200 yd, and sea-level rate of climb 1,400ft/min.

FOR BOMBING AND RECONNAISSANCE

P.7 Bourges I The Bourges I (serial number F2903) was a fast day bomber and reconnaissance aircraft, designed to be powered with two A.B.C. Dragonfly radial engines of 320 h.p. These engines were, indeed, fitted, though the machine was also flown with Bentley B.R.2 rotaries. Performance was of an exceptionally high order, being much the same as that of the Bobolink fighter, due to the clean, compact design. The engines were carried in streamlined nacelles between the wings, and the undercarriage was of split-axle type, of very wide track and modern appearance. Construction was of wood.

Measuring 54ft in span (57.3ft when balanced ailerons were later fitted), the Bourges had a wing area of 738 sq ft, weighed 3,420 lb empty, and had an ultimate gross weight of about 6,300 lb. Fuel capacity was 190 gallons, giving a potential endurance of over 9 hr, and top speed at 10,000ft was 124 m.p.h. Landing speed was only 50 m.p.h., and a height of 10,000ft could be reached in 11 min. F2903 was first flown in 1918, and was one of the first twin-engined aircraft on which aerobatics were performed. Armament was two Scarff-mounted Lewis guns, one in the nose and one in the dorsal position.

P.7a Bourges Ia Numbered F2904, this development of the Bourges I had a "gulled" centre-section (i.e. the inner sections of the top mainplanes were swept down to join the fuselage), and the nacelles for the Dragonfly engines were lowered to the bottom wings, the undercarriage was heightened to maintain airscrew clearance. The tailplane had a sharp dihedral angle.

P.7b Bourges II This development of the Bourges was numbered F2905, was powered by two Napier Lion engines, each of some 450 h.p., mounted on the lower wings, and was officially classed as a three-seat long-reconnaissance aircraft. It was probably the fastest twin-engined aircraft of its day, and it demonstrated its manœuvrability in the Royal Air Force Pageant at Hendon in 1923, when it was pitted in mock combat against two Jupiter-engined Gloucestershire-built Nieuport Nighthawk fighters. On this occasion the Bourges was repeatedly looped, rolled and spun. The gross weight of the Bourges II was 6,800 lb.

P.15 Bolton. Classed, like the Bourges II, as a three-seat long-reconnaissance aircraft, the Bolton was similarly powered by two Napier Lion engines. It was a larger machine, of 62ft 6in span, and weighed 9,500 lb all-up. The aircraft was first flown during 1922 and, apart from its high-tensile steel construction, exhibited many novel features. The Lion engines, for example, were left uncovered to an unusual extent, permitting radiators of relatively small size to be employed. A further advantage was that the exhaust silencers, of patented Boulton and Paul type, were very efficiently cooled. These silencers were aluminium manifolds, terminating in steel pipes in which saw-cuts had been made. Engine mountings were of special anti-vibration type, and the engines themselves were started by hand from the rear of the nacelles. The main petrol tanks were carried in the fuselage, constantly delivering to a feeder tank, likewise in the fuselage but at sufficient height to give gravity feed. In addition to the usual trimming tailplane, a "trimming fin" was employed, actuated by a wheel in the cockpit. The undercarriage, moreover, embodied a nosewheel designed to prevent the machine from nosing over in a bad landing. On the Bolton also a new type of Boulton and Paul oleo-pneumatic leg was incorporated in the main undercarriage.

P.25 Bugle I. A medium-range, three-seat bomber, the Bugle I was powered by two Bristol Jupiter IV engines and was first flown during 1924. It was principally of all-steel construction; the wings having box spars of corrugated steel strip, and steel ribs, and the inner pair of interplane struts being likewise of steel, whereas the outer ones were of Duralumin. The engine mountings were hinged, according to the patented Boulton and Paul method, and were built up mainly of circular-section tube, of Boulton and Paul "locked-joint" type, drawn from high-tensile steel strip. The fuselage was a rectangular framework with four longerons, these being built up of two drawn sections in such a manner that by cutting out one of the two sections a bearing was afforded on the remainder for an angle-plate, enabling struts or wires to be attached. Not only the main undercarriage, but the tail skid also,

was provided with oleo-pneumatic shock-absorption. The ailerons and rudder had inset horn balances and were of large area to afford maximum manœuvrability. Defensive armament was two Lewis guns, mounted on Scarff rings in the nose and in the dorsal position. Bombs were carried externally.

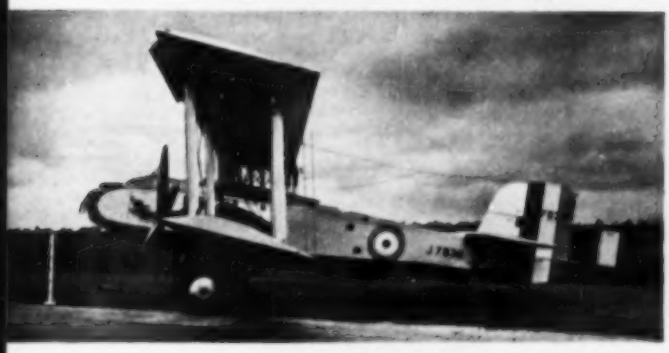
The Bugle I had a span of 62ft 6in, a wing area of 932 sq ft, a gross weight of 8,760 lb, and a disposable load of 3,681 lb. Sea-level speed was 120 m.p.h. and a height of 10,000ft was attained in 15½ minutes.

P.25a Bugle II. A refinement of the Mk I, the Bugle II had two Napier Lion engines mounted on the lower wings, and the external bomb carriers were faired in by a streamlined ventral structure. Performance was further increased by transferring the petrol tanks from beneath the upper wings to the fuselage. Gross weight was 9,000 lb.

P.29 Sidestrand I. In the years following the First World War Boulton and Paul were conducting extensive investigations into the aerodynamic properties of various combinations of wing, body and engine-nacelle forms in order to minimize interference effects, and in the Sidestrand three-seat day bomber (1927) an exceptional degree of efficiency was attained. Whereas the fuselage was a harmonious combination of curves, horizontal and vertical flying surfaces had a characteristic angularity. The power units were two Bristol Jupiter VIs, having swivelling mountings and set in nacelles on the lower wings. In addition to Lewis guns, in the nose and dorsal positions, there was a third gun giving covering fire beneath the tail.

Basis of the fuselage construction was the locked-joint circular-

P.29a Sidestrand III with Townend rings.



P.29a Sidestrand IIIS.

tube made from strip by a special process of rolling and drawing. Not only did the tube leave the drawbench dead straight, but the locked-joint seam itself was perfectly uniform—a matter of great importance because of the necessity for attaching fittings. Having evolved this satisfactory type of tube for longerons and struts, standardized in a number of different sizes, the next step was to design a neat type of fitting for the attachment of struts to longerons. This was achieved by means of a tubular "pad" of magnesium alloy, fitting snugly over the tubular longeron and with flat faces machined on the outside. Bolts passed through the pad and longeron vertically and horizontally, the strut ends being attached to the bolt heads and the bracing wires to sheet steel links or wiring plates. The wing structure was no less ingenious, and likewise made use of standardized spar flanges, webs and fittings in a manner which gave a sufficient number of combinations to meet well-nigh every demand without recourse to special rollers and dies.

The petrol tanks—three in number—were all in the fuselage, the total tankage being 260 gallons.

Span was 72ft, length 40ft 8in, wing area 943.5 sq ft, speed at sea level 125 m.p.h., speed at 5,000ft 130 m.p.h., empty weight 5,275 lb, and gross weight 8,850 lb.

P29a Sidestrand II. The Sidestrand I was progressively developed, modifications being made particularly to the ailerons, and the

P.29a Sidestrand III.

type was ordered for service with the R.A.F. under the designation Sidestrand II. Powered with Jupiter VI engines, Sidestrand IIs were issued to No. 101 Bomber Squadron, R.A.F. A feature of the aircraft was a redesigned, servo-type rudder, and the engines had nose-type collector rings with long tailpipes. Although official documents show that the designation Sidestrand II was applied to a machine fitted with Jupiter VIII geared engines, the geared-Jupiter version of the Sidestrand was known to the company and in the R.A.F. as the Sidestrand III.

P.29a Sidestrand III. The Sidestrands of No. 101 Squadron were progressively re-engined with Jupiter VIII and VIIIF geared engines, with a notable increase in performance. Handley Page automatic slots were standardized, and the gross weight was 9,963 lb. An official publication gave the bomb load as two 230 lb or 250 lb bombs, plus a universal carrier for one 520 lb or 550 lb, two 230 lb or 250 lb, or four 112 lb bombs. Additionally there was a light series carrier for four 20 lb sighter or practice bombs. The bomb-sight was of the Mk 2H (high-speed) course-setting type. Two-way wireless, oxygen, and a P.7 or an F.8 camera were specified.

Townend rings were fitted experimentally but were not standardized because of cooling difficulties. Like its predecessors, the Sidestrand III was extremely manœuvrable and capable of most aerobatics. It could maintain level flight or climb on one engine with full load, and its steadiness as a gun platform is attested by the fact that soon after the type became operational all R.A.F. bombing records for accuracy were broken.

Data for the Sidestrand III, with Jupiter VIII engines, were: Weight empty 6,010 lb, fuel 1,780 lb, oil 230 lb, military load (including crew) 2,180 lb, gross weight 10,200 lb, wing loading 10.6 lb/sq ft, power loading 10.2 lb/h.p., top speed at 10,000ft 140 m.p.h., climb to 15,000ft 19 min, service ceiling 24,000ft, landing speed 54 m.p.h.

P.29a. Sidestrand IIIS. This designation distinguished Sidestrand III J7939 as fitted with Bristol Jupiter XFB geared and supercharged engines, at one time with Townend rings. Flying at a weight of 10,200 lb, this aircraft achieved 167 m.p.h. at 11,000ft. Time of climb to 11,000ft was 8½ min, and service ceiling 30,000ft.

P.75 Overstrand I. So high was the performance of the Sidestrand that difficulty was experienced in handling the Lewis guns, particularly that mounted on the Scarff ring in the extreme nose. Boulton and Paul, therefore, sought to provide some means of shielding the front gunner from the airstream and, after experimenting in various directions, designed their first totally enclosed power-operated turret, which was installed in a modified version of the Sidestrand, known as the Overstrand. The fitment of the turret, however, was only one of many innovations. The pilot's cockpit was entirely enclosed and the rear dorsal gun position was provided with an effective form of windshield. Crew comfort was further increased by a controllable hot-air supply, drawn from an air-heater built into the exhaust system of one of the engines, and an automatic pilot was fitted as standard. The airframe was stiffened up to permit flight at a gross weight of 12,000 lb, and the

P.75 Overstrand I (prototype).

P.32 bomber.

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bomb load was increased to about 1,500 lb. Full day and night flying equipment was installed. The Jupiter engines were changed for Pegasus IIM3s, which gave a top speed of 153 m.p.h. at 6,500ft, 144 m.p.h. at 15,000ft, and a take-off run, at full load, of 200 yd.

In service with 101 Squadron the nose turret was an immediate success. Gunnery trials with flag targets showed that it increased the average number of hits from something of the order of 15 per cent to about 85 per cent, and it was this success which led the company to go ahead with new developments in this direction. The Overstrand nose turret was a cylindrical structure with hemispherical ends. An air compressor was mounted on one of the engines and the compressed air supply was taken through a rotating joint at the base of the turret to feed an air motor, by means of which the turret was rotated. Direction of rotation was controlled by two plunger valves operated by the barrel of the single Lewis gun, when the gun was pointed slightly to one side or the other, so that the gunner had only to follow the target with his sights to bring about the desired rotation. A vertical slot in the turret wall enabled the gun to be moved vertically, and its supporting arm was connected hydraulically to a plunger carrying the gunner's seat, so that the weight of the gunner counterbalanced that of the gun.

P.32. Generally following Sidestrand lines, but much larger and having a third engine mounted on the top plane, the P.32 was a four-seater night bomber, built in 1931. The engines were medium-supercharged Bristol Pegasus, with combined Townend ring and exhaust-collector cowlings, and the main undercarriage was four-wheeled. In addition to the nose gun, on a Scarff ring, and a dorsal gun, similarly mounted, there was a third gun position in the extreme rear end of the fuselage, aft of the twin-finned tailplane. The wings spanned 100ft, but could be folded to a width of 47ft 6in; length was 69ft, and gross weight 22,700 lb. By mounting the third engine on the top wing the nose was left clear for bomb-aiming and gunnery. The Sidestrand system of construction was generally followed, and the elevators and rudder were servo-operated. The P.32 made its first public appearance in the R.A.F. Display of 1932.

TRAINERS

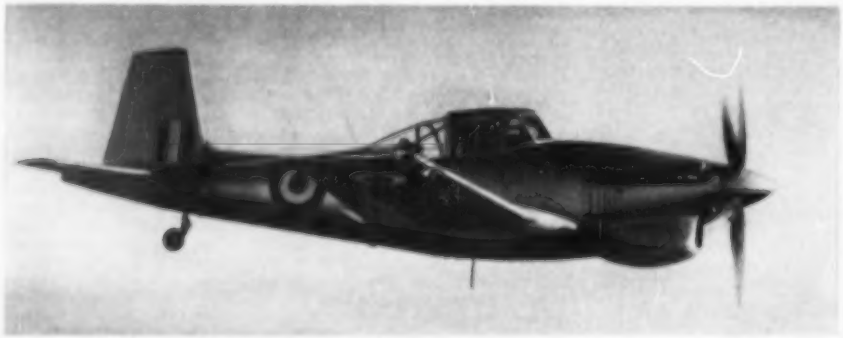
P.108 (Bristol Mercury) Specification T.7/45 called for an advanced trainer for the R.A.F., to be fitted with an Armstrong Siddeley Mamba or Rolls-Royce Dart turboprop. The Boulton Paul project P.108 was prepared to this specification and was accepted, but development difficulties with the new powerplants necessitated installing a Bristol Mercury 25 piston engine to obtain flying experience. Thus powered, the P.108 first flew on May 30th, 1947. A two/three-seater (the third seat at the rear was for an observer or navigator), the P.108 was of all-metal construction, had a span of 39ft 4in, a normal loaded weight of 7,595 lb, and achieved a top speed of about 280 m.p.h. at 10,000ft.

The original P.108—VL892—was subsequently re-engined with an Armstrong Siddeley Mamba turboprop and otherwise converted up to Balliol Mk 1 standard (see below). In its new form it served with the Armstrong Siddeley company as a development aircraft.

P.108 Balliol T.1 The foregoing was the official name conferred on the turboprop version of the P.108. The jet efflux was led through a pipe below the cockpit floor and out through the lower starboard side of the fuselage. An advantage of this location was that the jet tended to counteract the effect of airscrew torque. The airscrew was a constant-speed, fully feathering, three-blade de Havilland. Powered with a Mamba of 1,010 shaft h.p. plus 320 lb jet thrust, the Balliol T.1 weighed 7,845 lb all-up, and had a maximum speed of slightly over 200 m.p.h. at 20,000ft.

P.108 Balliol T.2 A change in official policy led to the installation, in this mark of Balliol, of a Rolls-Royce Merlin 35 liquid-cooled piston engine rated at 1,245 h.p. at 11,500ft. At the same time, the third seat was deleted and various other modifications incorporated. The following description applies to the Balliol T.2 as now used by the R.A.F.

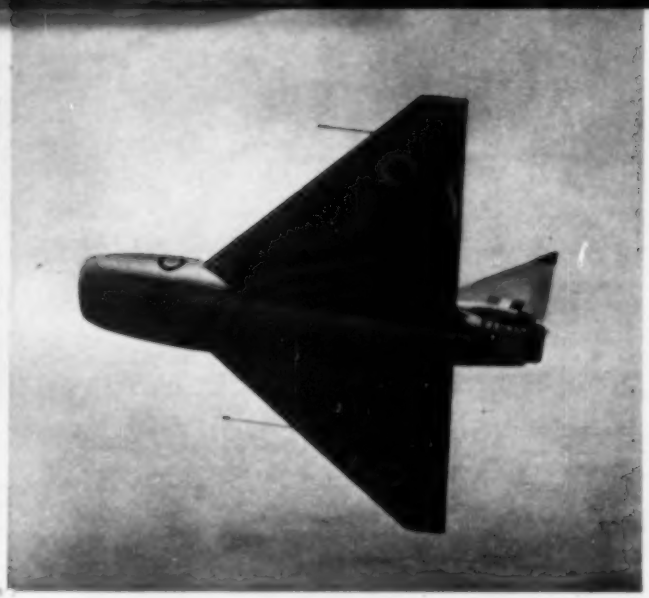
Construction is all-metal. The inner wings are attached to the fuselage by four pin bolts, and the outer wings are similarly attached to the inner sections with a latch gear to withdraw the



P.108 Balliol T.2

Above, P.108 (Bristol Mercury); below, P.108 Balliol T.1.

Above, P.108 Balliol T.1. (converted from Mercury prototype); below, P.108 Sea Balliol T.1.



P.111.

lower pair of bolts and permit upward folding. The two spars are of 33 per cent and 70 per cent chord, the portion between the spars forming a rigid torsion box. Ailerons are interchangeable from port to starboard. The fuselage is a circular-section light-alloy monocoque, with a light-alloy and steel-tube structure forward of the engine bulkhead forming part of the detachable powerplant. The cockpit section incorporates a stiff tubular crash pylon behind the seats. The tail fin is identical with, and interchangeable with, either half of the tailplane, and the port and starboard elevators are likewise interchangeable. Also transferable port to starboard are the oleo-pneumatic shock-absorber legs, with 11.6in travel. The non-retracting tailwheel is steerable, but the steering connection can be disengaged at will. Retraction and the lowering of the main undercarriage, and operation of the wheel brakes, flaps, air brakes, radiator flap, hot-air intake flap, and filter screens (for simulating night-flying conditions) are effected pneumatically from a main air cylinder, the pressure of which is maintained at 1,000 lb/sq in by an engine-driven compressor. Equipment can include gyro gunsights and a 0.303in Browning gun fixed in the port wing, and four rocket projectiles or eight light bombs can be carried, if required.

In service the Balliol has shown itself to be a durable, easily maintained aircraft, and highly manœuvrable. Current particulars are: Span 39ft 4in; length, 35ft 1½in; wing area, 250 sq ft; weight empty, with fixed equipment, 6,730 lb; gross weight, 8,410 lb; wing loading, 33.64 lb/sq ft; top speed at 9,000ft, 288 m.p.h.; max. continuous cruising speed (rich mixture) at 8,000ft, 266 m.p.h.; stalling speed, 83 m.p.h.; climb to 10,000ft, 6 min; take-off distance to clear 50ft, 450 yd; landing distance from 50ft, 650 yd; endurance at 220 m.p.h. at 10,000ft, 3 hr; max. rate of roll, 105 deg/sec.

During 1952 Balliols were used experimentally in the night ground-attack role.

P.108 Sea Balliol T.21 This is a version of the Balliol T.2 for the Royal Navy, with which Service it is now operating in some quantity. Features include a new type of undercarriage, capable of absorbing a vertical velocity of 14ft/sec, and an arrester hook, the extra weight of which (and of the stiffened tail cone structure) is offset by moving the accumulators forward to positions in the inner wings. The tailwheel unit incorporates a double-extension oleo-pneumatic shock-absorber. In conformity with naval requirements, an external air-speed indicator is introduced for deck landing, and the layout of the cockpit is altered in several respects. A four-blade airscrew, of smaller diameter than that of the Balliol T.2's three-blader, is fitted.

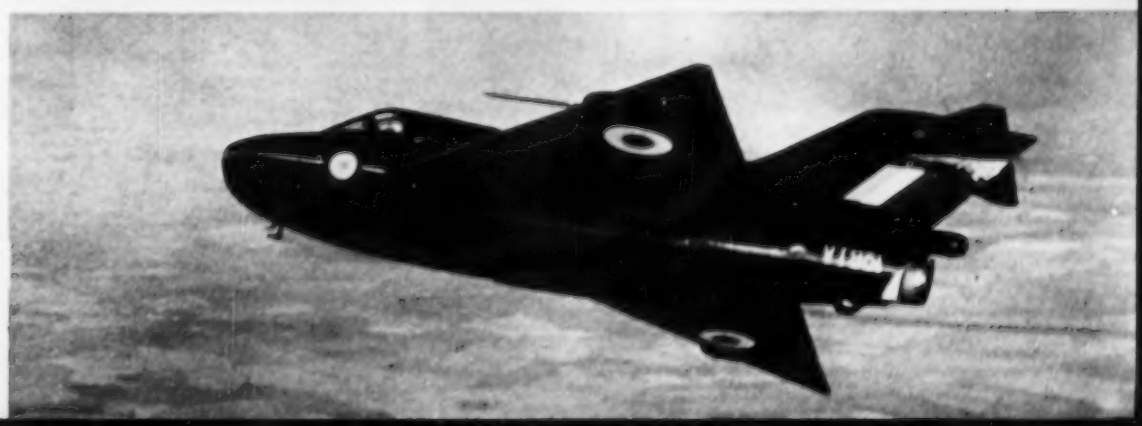
DELTAS FOR RESEARCH

P.111 On October 10th, 1950, the first flight of this delta-wing single-seater, built for high-speed research, was made at Boscombe Down. A mid-wing monoplane, it was characterized by a short fuselage, very broad at its forward end, and having an elliptical nose intake for the Rolls-Royce Nene turbojet, of some 5,000 lb static thrust. Control was effected by means of powered, wing-mounted elevons, and by a rudder inset into the tail triangular fin. A braking parachute was carried in a fairing on the port side of the rear fuselage. Detachable wing-tips enabled comparative tests to be made with blunted and pointed configurations. When demonstrated at Farnborough in 1951, the P.111 displayed an extremely high rate of roll. The span was 33ft 6in, and length 26ft 1in.

P.111A A modified version of the P.111, this has fuselage-mounted air brakes, a revised control system and other internal modifications. It was first flown on July 2nd, 1953.

P.120 Generally similar to the P.111, the P.120 was fitted with an all-moving tailplane mounted on the low-aspect-ratio fin. The machine first flew on August 6th, 1952, but was destroyed (after having flown for several hours) on the 29th of the same month, when it developed an obscure form of flutter which resulted in structural failure. Although A. E. "Ben" Gunn, Boulton Paul's chief test pilot, stayed with the machine for over half an hour in attempting to bring it down safely, he was finally obliged to abandon the aircraft by parachute, after finding it impossible to maintain an even keel at speeds below 300 m.p.h.

P.111A.



P.120.

BOBOLINK TO DELTA . . . **Part III**

TEST FLYING 1918-1926

by CAPT. FRANK T. COURTNEY

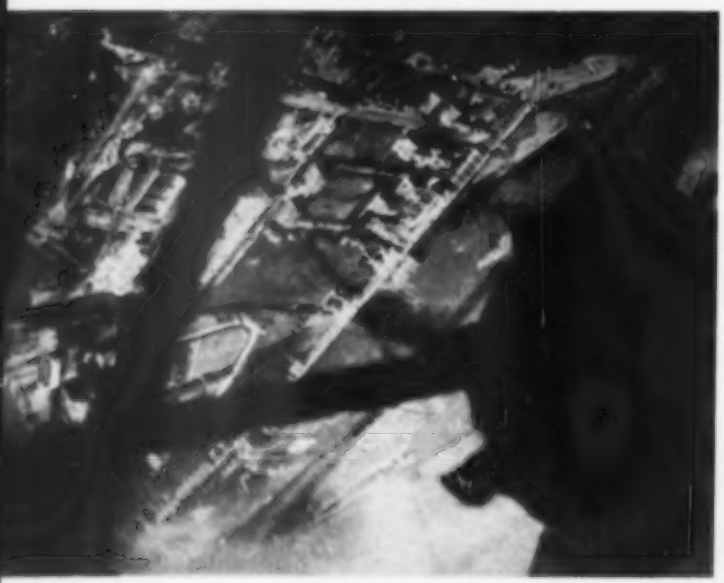
IN the spring of 1918, whilst stationed at London Colney, I was asked by the Air Ministry (or whatever it was called at the time) if I would like to go to Boulton and Paul at Norwich as Air Force test pilot. It sounded like a cushy job and I grabbed it. Actually it turned out to be something much better than that, for it led to many years of some of my most varied and interesting flying experiences, as well as extremely pleasant personal associations —which still continue.

When I went there I was not quite a stranger, for John D. North, their chief engineer, had been chief engineer at the Grahame-White Company at Hendon where I had been an apprentice before World War I. North had his own peculiar methods of instructing apprentices: a sarcastic approach which made one feel a complete damn fool unless one completely grasped the point at issue; and it was not until I was sent to Farnborough in 1916 that I realized how much I had learned from him at Hendon. I now hoped to learn a lot more from him at Norwich—and I did.

My first job was to continue the tests of the Bobolink, a single-seat fighter which lost out to the competitive Sopwith Snipe. My principal project was, however, the forthcoming Bourges, a twin-engined bomber which was the precursor of the Sidestrand, Overstrand and other related aircraft. Hindsight rarely awards much credit to aircraft designs—one can always see five or ten years later how much better one could have done a job—but the Bourges continues to stand out in my mind as a remarkably excellent piece of work for its time. It is certain that, but for the aviation slump of the 'twenties, the Bourges (or at least its descendants) would have attained historical renown.

The Bourges was designed for two A.B.C. engines of (I think) some 350 h.p. However, production lagged and these engines were not forthcoming (as it happened, they were no good when they did turn up). So, rather than let the Bourges sit around doing nothing, it was decided to take the questionable course of fitting two B.R.2 rotary engines of much lower power in order at least to get some flight tests done. The Bourges responded unexpectedly and magnificently, and it still remains one of the four landplane types which I have most enjoyed flying (the others being the Camel, the Bristol Fighter and the Siskin).

Aerobatics in the Bourges I—a 1919 "Flight" picture by John Yoxall.



Great pilot, great aeroplane: Frank Courtney with the Bourges I in 1919.

Taken especially for "Flight," this picture shows Frank Courtney (left) as he is today. On the right is Bill Nicholls (formerly of Boulton Paul and "Flight") and in the centre "Skeets" Coleman, pilot of the Convair XFY-1 v.t.o. Pogo-Stick. Courtney and Nicholls are members of Convair's engineering department.

The performance of the Bourges was excellent, and its handling qualities (which are a function of general design and not merely control design) were astonishing. As a result, I was able to make its structural qualities speak for themselves. Starting off with a few loops, I soon found that I could make the Bourges perform like an oversized Camel. By shutting off one engine or the other, or by varying throttle settings, I managed to make differential thrust compensate for any sluggishness due to greater dimensions; and, as in the case of the Camel, one could use the gyroscopic effect of the rotary engines for added yawing or pitching forces. Thus the Bourges could be thrown around in loops, spins, rolls or any other freak manœuvre that one could think up, without any special effort at all. I gathered that my show at Hendon, at the reception for Commander Read and his transatlantic NC-4 flying-boat crew in 1919, caused something of a sensation as to what a twin-engined bomber could do. A couple of years ago I had dinner in Washington with Admiral Read and we did a little more hangar-flying in the Bourges.

Another project of B. and P. gave me much interest, fun and excitement. The American Army Air Corps had bought a bunch of Gnome Monosoupape 150 h.p. engines and wanted to put them into Camels. B. and P., who were building Camels in production, got the job of revising and producing a line of them with that noisy, temperamental and (when it ran) powerful engine. I got the job of testing them, and American headquarters in London suggested that I keep one practically for myself so that I could "run the hell out of it" for test purposes. (Incidentally, my American connections on that project resulted directly in my eventually coming to the U.S.A.)

The history of the Mono Camel was brief but highly eventful; B. and P. built wonderful Camels, but they could not control the mixed marriage with the Monos, and this was one more problem which was removed by the ending of the war. For myself, I got a lot of fun out of it. Among other strange features was the fact that this Mono was "throttled" by a selector switch which progressively cut out one cylinder after another, until it was fully throttled by running on one cylinder only—with a noise exactly like the firing of a machine gun. One day, having a lunch appointment at Harling Road, I turned up by diving on the hangars with

the selector switch on "No. 1." There was a wild rush for shelter; and when I landed, expecting hearty laughter, I was nearly lynched. I hurried back to Norwich to tell *my* story to B. and P. before the official report got in.

It was through B. and P. that I got really into the seaplane business, which has been my greatest aviation interest ever since. One of their jobs was the building of hulls for the big F.3 and F.5 flying-boats and they made a most beautiful job of it. In mid-1918 they were commissioned by the Government to set up a National Seaplane factory and I was assigned to assist in surveying various possibilities for a suitable site on one of the Norfolk Broads. I had little seaplane experience at the time so it was decided that I should undergo an intensive refresher course at the nearby Yarmouth air station. There, under such masters of the seaplane arts as Cadbury and Lecky, I was checked out on all sorts of craft from the little Sopwith Schneiders to the big F-boats. The National Factory project was abandoned through the ending of the war but the experience I had obtained led to my getting an expanding series of seaplane test jobs in the post-war period.

After the war, when I was demobilized, I continued my work on the development of B. and P. aircraft as a civilian on a consulting basis (so that, in fact, I was never actually on their staff). During this period I handled several experimental aircraft of great interest, including the Bolton, the first of the high-tensile-steel jobs, and the Bodmin, which had two engines in the fuselage driving four propellers through shafts and gears. Curiously enough, after the numerous transmission troubles had been corrected in ground-running, this complex aircraft gave singularly little trouble in flight.

I learned a great deal from all this work. I had only one crash, which occurred on a type known as the Atlantic. This was a sort of modified Bourges, with two (then very powerful) Napier Lion engines, which the directors, with their usual sportsmanship and enterprise, had agreed to build for the immediate post-war *Daily Mail* transatlantic prize. In fact, they even went to the extent of building two aircraft in case something happened to one of them.

The design contained a number of very interesting and advanced features, but time was against us. In the haste to get flight tests done as soon as possible, I ran up the two engines separately, thus failing to discover a defect in the fuel system which prevented a sufficient supply to both engines together. One engine cut out just as I took off and the machine went into a yawing dive before I could correct the situation. The cockpit was an interesting integral structure which just broke off with me in it, and I wasn't hurt.

Alcock and Brown got across the Atlantic before anything more could be done, but I later flew the second machine, which performed very well. (Incidentally, some nine years were to pass before I attempted the Atlantic—this time on a Dornier, again with two Napier engines. I fell into the middle; and, although I ferried dozens of aircraft over the Pacific during the last war, I still haven't flown the Atlantic.)

The relationship at that time between the firm's directors and the strictly aviation people was a rather curious one. With the exception of Capt. J. D. Paul, I don't think any of the directors knew, or pretended to know, anything whatever about aviation as such. They did know, however, that it was highly important to the current war effort and that, somehow or other, it had a great future. Consequently they paid close and earnest attention to the quality of their products, and no aircraft were better or more carefully built than those of B. and P., a fact which was deeply appreciated by those of us who had to fly in them. However, actual flying was not for them (I believe I did once entice Mr. Howes up for a short flight) and they apparently considered people like myself as noble heroes in a dangerous but necessary business, so that we constituted a mutual admiration society which is pleasant to remember.

I retain vivid memories of Charlie Brown, my mechanic on the Bourges, leaning casually out of the front cockpit whilst we were rolling or spinning; of Martin, the inspector, busily tending the mechanisms in the "engine room" of the Bodmin whilst, low on fuel, I was trying to get back into Mousehold in a thunderstorm; of Odgers and Sayers in uproarious aerodynamic arguments; of "Old Man ffiske" striding up and down at a Board meeting with riding breeches and crop. It is hard to believe that all that was so long ago.

After several years the work of Boulton and Paul reached a point where they were able to engage a full-time pilot, and when C. A. Rea joined them my work for them came to an end. Unfortunately I have not maintained direct contact, especially since they moved to Wolverhampton; but my very pleasant recollections of those earlier days still remain and I am always running into someone who says: "Of course, I remember you when you were with Boulton and Paul." One such is Bill Nicholls, formerly of B. and P., who is now with me in Convair's engineering department.

There was one event at B. and P. which I tend to remember: one 1918 day I was driving from the Rose Lane works at Norwich to the Riverside factory when one of the telephone operators asked me to give her a lift to Riverside. She never quite got rid of me after that and, at this moment, she is in the next room building a Dry Martini—with which I think we should drink to the continued prosperity of Boulton Paul.

Frank Courtney looping the Bourges I over Hendon.

1926-1935

by S/L. C. A. REA, A.F.C., A.M.I.Mech.E., A.F.R.Ae.S.

TOWARDS the completion of my R.A.F. service my C.O. at the M.A.E.E., Felixstowe (the late G/C. Maycock), put me in touch with the London Office of Boulton and Paul, Ltd. The manager (the late Mr. Guy ffiske) had asked him if he knew of a pilot of some experience who, in addition to test-flying, could assist the technical staff from the Service standpoint. Up till that time the firm had employed free-lance pilots, like Frank Courtney, but now proposed to have their own test pilot and Service representative. I wrote to Mr. ffiske and he arranged for me to meet him and Mr. J. D. North. I joined the Company in July, 1926.

My first meeting with Mr. North impressed on me his keen sense of humour and during subsequent years, when we had the usual wordy arguments which generally arise between test pilots and the design staff, this characteristic of his tided over many more-or-less difficult situations. I distinctly recollect a fierce argument between Mr. North, the late H. A. Hughes (who was responsible for detail design) and me, when I endeavoured to put over what I thought was the Service view on some question of design. This was not acceptable, and I left the conference hurriedly in a "take it or leave it" mood, feeling I had rather upset Mr. Hughes. A few minutes later Mr. North followed me and to my surprise said, "Let us have some more of these arguments; the staff can learn a lot from them." With this sort of spirit in the firm good results were bound to accrue.

On arrival at the Norwich works I was shown the prototype Sidestrand, fitted with two Jupiter VI engines, and at once felt that in it we had a most promising aircraft. It was to be ready for flight shortly and I looked forward to my first test for the firm with pleasurable anticipation.

I was told that a small two-seater—the P.9— was available for my personal use and for visits to R.A.F. units and other aircraft firms when necessary. I also raced it successfully at the ill-fated Bournemouth flying meeting in 1927 when I won two first prizes and one second and missed another first by passing on the wrong side of the finishing pylon rather than fly too close to another competitor. This was the meeting at which S/L. Longton and Major Openshaw collided with fatal results to both.

Shortly after the meeting a gold cigarette case, suitably inscribed, reached me at Norwich, together with a eulogy on the flying qualities of the P.9 and its pilot. I was very surprised to find that the sender was a well-known bookmaker who apparently had done well out of the performance of the "dark-horse" P.9. Many years later I was able to give some slight assistance to this sportsman when he was trying to get his son into the R.A.F.

About six P.9s were made and I often thought development should have been continued as the type had a good turn of speed and was, in many ways, ahead of its time. It had, for instance, two suitcases fitted into the top of the fuselage behind the passenger's seat; these were shaped to the fuselage contour and could be removed in a matter of moments. Powered with a 90 h.p. Raf engine, driving a four-bladed airscrew, it could do well over 100 m.p.h., was easy to fly and quite reliable, provided one did not run the engine at full throttle for too long. Mine was finally written off by a pilot who borrowed it, when the engine failed from this cause.

The first flight of the Sidestrand was marred by a slight accident after landing, when one of the wings struck a hockey goal-post at a corner of Mousehold aerodrome. For some time I had

BOBOLINK TO DELTA . . .

been convinced that while there appeared to be ample downward movement of the elevator the upward travel was insufficient. Feeling a little diffident about criticizing the design directly I had joined the firm I did, nevertheless, discuss my misgivings with Mr. North, who gave instructions that the elevator movements and controls should be re-checked. This was done and I was told everything was correct. Still dissatisfied I told Mr. North that no doubt I could land the aircraft without accident, but that it would have to be at high speed, and eventually I took off with a passenger in the rear-gunner's position but none in front. Even with this help it was impossible to land with the tail down, and in order to prevent the nose dropping I approached at nearly 90 m.p.h. It took the entire aerodrome width to accommodate the landing run, which finished a few yards from the boundary hedge. After this I refused to fly the machine again until the elevator had been altered. Further investigation disclosed a mathematical error in the design of the elevator controls which had reduced the upward movement by over 30 per cent.

I learnt a lot from this incident and it taught me to dig my toes in when I felt it was essential to do so.

At Martlesham Heath the prototype Sidestrand made a good impression, but lateral control was considered too heavy and Frise ailerons were tried with highly satisfactory results. An out-rigger servo was next fitted to the rudder, and finally H.P. slots to the top wings, so that the machine became highly manœuvrable for its size, and many will still remember its remarkable aerobatic displays at Hendon Pageants.

After some time the firm received its first production order and No. 101 Squadron was equipped with the Sidestrand—and subsequently the Overstrand, which was the first aircraft to be flown with a totally enclosed power-operated turret for the front gunner.

Capt. J. Dawson Paul, who was chairman of the firm's Board, decided to take up flying and quickly passed his tests under my tuition; but in discussions with members of the design staff I realized that many of them had little or no practical experience of flight and I obtained Mr. North's permission to take them for short flights in the P.9 as and when opportunities arose.

The design and drawing offices were moved up to Mousehold aerodrome, about a mile from the main Riverside Works in Norwich and these flights were thus easily arranged. I feel sure it proved helpful; at any rate they were very popular and the demand grew to such an extent that we had to ease up, especially as the departments concerned were now extremely busy on new designs. Among these were the Bittern and Partridge, the former being a twin-engined night fighter powered by two Armstrong-Siddeley Lynx engines. It was a cantilever monoplane; the wings, however, proved to be too flexible, necessitating a major modification involving bracing struts from the wings to the undercarriage. That of course, reduced the performance considerably. The aircraft was duly delivered to Martlesham and although very pleasant to fly in its modified form failed to qualify for a production order.

The Partridge was also to an official order, to meet an exacting specification for a single-seat fighter. In its original form, it looked likely to make its mark—apart from the position of the undercarriage-strut attachments, which were too close together. These were modified, but shortly before delivery to Martlesham official policy called for re-positioning of the gun mountings much lower than originally planned. The only way this could be achieved was by altering the almost perfect shape of the fuselage by adding "bulges," which entirely spoiled the appearance of the machine and reduced its performance considerably. This precluded any hope of securing a production order.

At Mousehold in 1933: (l. to r.) Major Jack Stewart, O.B.E., Capt. J. Dawson Paul, John Carter, J. D. North, S/L. C. A. Rea, A.F.C.

Flown by S/L. Rea, the Mail Carrier comes in to Mousehold.

While on a test flight on the Partridge late one winter afternoon I was so busy taking down performance figures that on reaching about 16,000ft (without oxygen, of course) I found I was completely lost in a heavy snow storm. After some anxious moments occupied by a flat dive in an easterly direction I found the coast and soon located Mousehold, where I landed in almost complete darkness.

The little Phoenix proved very pleasant to fly, but was underpowered for a two-seater, and although flown by many pilots of varying experience (all of whom reported favourably on its handling and flying characteristics) it was decided not to proceed with quantity production. I took many passengers for flights in the Phoenix, among them General Brancker who always showed such encouraging interest in any type of civil aircraft.

When Mr. Guy Iliske, who managed the London office, died after a short illness, Major Jack Stewart, O.B.E., took over his duties, and at about this time the firm secured an official order for a twin-engined mail-carrying aircraft design to transport a ton of mail for 1,000 miles at 150 m.p.h. On the first flight I took off at high speed and landed again successfully; but on the second attempt I found I was unable to correct a pronounced swing to the right, which rapidly developed to such an extent that I had to cut the throttles and apply the brakes. These however proved practically useless at high ground speeds although moderately effective for taxying. I complained about the brakes and was told they were correctly adjusted to satisfy official requirements. Later I found that the retarding effect had been considerably reduced by agreement of resident Ministry officials and the firm's technicians. There is not the slightest doubt that had the full braking power been available the subsequent accident could have been easily avoided; but I could not stop the ground run before colliding with a fence of the sheep pen variety surrounding a cricket pitch. I still thought all would be well, but shut off the fuel as a precaution. However, when the main wheels struck the fence they flattened it without breaking the wiring which retained the uprights in position; but when the tail-wheel made contact with the fence it had sprung up again. The tail was thrown upwards and the machine turned over on its back.

Eventually it was found that at small angles the rudder was almost completely blanketed—this in spite of extensive model tests at the R.A.E. On subsequent inquiries there I found that readings had only been taken at neutral, medium and maximum angles and no readings covering the small angles used in flight had been taken.

A major modification which included the fitting of twin rudders in the slip-streams overcame the defect, and I duly delivered the aircraft to Martlesham. It crashed there while on test and was completely destroyed, though the pilot escaped with only minor injuries.

The last product of the firm which I tested was the first of two feeder-liners for the then Imperial Airways. The late F/L. C. Feather made his first test for the company on the second one.

The aircraft branch had now grown to considerable size and it was decided to form a new company to take over the business which, in addition to making complete aircraft, had also developed its own patented method of constructing metal wings and other

components, and was thus a valuable acquisition. The public flotation of Boulton Paul Aircraft, Ltd., followed, with Mr. North and Mr. S. Hiscocks as joint managing directors, and for various reasons—particularly labour—it was arranged to re-establish the works at Wolverhampton, where the present factory was built to the management's own requirements. Not wishing to live in the Midlands I severed my long and pleasant connection with the Norwich works and founded my own business at Mousehold, occupying the same sheds in which the Sidestrands and Overstrands had been erected.

Eventually my concern bought all the surrounding buildings with 15 acres of land, and undertook the manufacture of seaplane floats, and many other components, among which were some items for the Defiant.

Among those I knew at Norwich I have already mentioned H. A. Hughes, who lost his life when returning from a visit to America on the firm's business when his ship was torpedoed. Many will also remember the late "Doc" (or Digger) Odgers, who was the firm's metallurgist and subsequently works manager. Another who held this position was J. B. Purefoy, who now manages his own successful engineering business in Surrey, where some of the old Norwich staff have joined him. Major Noble, now retired, held this post when I arrived in Norwich, while W. J. Pickthorn was then, and still is, responsible for publicity. Others who moved to Wolverhampton included Mr. Johnston who was responsible for stressing (and seldom seen without his super slide-rule); Freeman, in charge of the wind tunnel; Williams, chief of the drawing office; Clarke, who dealt with installation details and cockpit layout; and many others whom it is a pleasure to see again on my all-too-infrequent visits to the Midlands.

MODERN TIMES

by A. E. GUNN

A. E. ("Ben") Gunn.

ON arrival at the Wolverhampton works of Boulton Paul in February, 1949, I was surprised at the variety of projects in hand. On the production side Wellingtons were being re-furbished and converted to T.10 trainers. A Lancaster, with a rather ominous probe protruding from the nose, was tucked in one corner of the flight apron. Mamba- and Merlin-Balliol prototypes were in various stages of construction, and, behind those typical aircraft industry black curtains marked "No unauthorized persons are permitted to enter this compound," a Shape—that of the P.111 tailless delta research aeroplane.

I had been seconded from my duties at A.&A.E.E., Boscombe Down because of the tragic loss of the company's test pilots, Lindsay Neale and Tisshaw. My task was to continue the flight-test programme for the firm until arrangements were completed regarding new test-flying personnel. I soon found that my task was a formidable one indeed—the proving of the prototype Merlin-Balliol trainer to the standard required before Service trials at A.&A.E.E. A considerable amount of test flying had been carried out on this type, but some unpleasant handling characteristics had been noticed. During my first flights I considered the aircraft pleasant to fly, and ideal for its rôle of advanced trainer. The adverse handling characteristics were not insurmountable and could be cured, given sufficient time. Unfortunately this was, as usual, the one commodity the firm could not control; we were in direct competition with the Avro Athena. The most formidable adverse handling characteristic to be considered was an unpleasant stick-force reversal in an out-of-trim dive. Both the aerodynamics personnel and myself were clear in our minds how, if not to cure this reversal, at least to delay its effect above the maximum permissible diving speed. With extremely hard day-and-night work by the experimental shop, the major modification of cocking down the tailplane 2 deg was completed. This modification was most effective and, with small alterations to the air brakes, the aircraft was despatched to Boscombe Down.

During this period I was joined on the test-flying side by Dicky Mancus, ex-naval pilot from Aero Flight, R.A.E., Farnborough. To him fell the task of proving the Sea Balliol T.21. Both types of aircraft have now completed four years of service in the R.A.F. and the Royal Navy.

As Balliol production moved steadily forward a considerable amount of interesting test flying was done on various types of aircraft: the Gust Alleviation Lancaster, with its rather startling innovation—from the pilot's point of view—of cocking both ailerons up together when a gust was simulated on the electronic power-control system: the Nene-engined Vampire, capable of attaining in level flight the designer's maximum permissible air speed; Vampires and Hornets with a varied assortment of target equipment; and, of course, the seemingly endless trial installations on Balliols.

In the meantime the P.111 research delta had been despatched to Boscombe Down for initial flights. As this aircraft had been initiated by R.A.E., Farnborough, under direct contract, I did not have the privilege of carrying out the first flight, although I subsequently joined in the research programme. It was obvious that this aircraft would create a number of problems from the test-flying point of view, but from the initial high-speed taxying trials it was also obvious that we had reached a new era in first-flight technique. It was impossible, because of runway length, to carry out the test pilot's "confidence-builder" before first flight (commonly known as "hops"). Great credit must therefore be given to S/L. Smyth, O.C. Aero Flight at this time, for his confidence in the work of this company in taking this aircraft on its first flight. During its stay at Boscombe Down, the aircraft met with the usual prototype teething troubles and unexpected problems. It was pleasant to fly, but as speed increased it became difficult to handle, due to the extremely sensitive control arrangements. One must mention here the excellent work carried out by "Jock" Elliot in this high-speed field. It was quite evident by this time that a major modification was required to the pilot's simulated feel system, and the aircraft was duly grounded and returned to Wolverhampton.

On a bright August morning in 1952 I found myself once again at Boscombe Down. On the flight apron was the black shape of the P.120 research delta, referred to jokingly by Boscombe test pilots as the Black Widow-maker. On that morning I did not realize how near the truth this remark would be. This aircraft was of similar construction to the P.111, but fitted with an all moving tailplane at the top of the swept fin and rudder. Also it had extremely powerful air-brakes. With the experience gained on the P.111 I was not in the least worried about the first flight—that is, until I had used approximately three-quarters of the long runway at Boscombe and found myself, at 175 kt, still firmly on the ground. I shall never forget the look of startled amazement on the faces of the fatigue squad picking potatoes at the end of the runway as this black shape scraped over their heads, clawing frantically for altitude. No blame is attached to anyone for this extremely nerve-racking take-off. A general misconception both by our own people and R.A.E. and over-cautiousness as regards the first-flight tailplane setting were responsible. The general flying characteristics were more pleasant than those of the P.111, and the aircraft at high speed did not have that "sitting on a knife-edge" feeling. Unfortunately the life of this aircraft was extremely short. On August 28th, 1952, it was my doubtful privilege to be the first to eject successfully from a delta aircraft.

With the normal control system all disturbances of the control surfaces are usually apparent to the pilot through his control column. Having a power-operated no-feed-back system, no vibration occurred on the control column, although an intense flutter had been initiated on the port elevon. This resulted in a complete hinge fracture and loss of this rather important part of the aeroplane. Some hard work, using the remaining elevon and trimming tailplane, kept the aircraft in the air, but it was obvious that even to attempt a wheels-up landing was impossible. Yet another aircraft made its mark on Salisbury Plain.

Back at the main factory, Balliol production was now nearing its end and to remain in the aviation field it was necessary to find alternative flying facilities, Wolverhampton being a small grass field unsuitable for jets. After a brief sojourn at Seighford, final arrangements were made to use R.R.E., Defford. The flight test-section is now firmly established at this base.

I must risk boring the reader with one more triangular shape—the P.111A. Due to its vivid yellow colouring it did not take the pilots at Boscombe Down very long to think up a name. Quite often over the R/T would come the familiar cry "Clear the circuit: the Yellow Peril is airborne." Security measures prevent any remarks on the performance and handling characteristics of this aircraft. I can say, however, that it is equipped with many advanced refinements to the pilot's controls, and is considered pleasant to fly throughout the speed range. This aircraft is now the property of Aero Flight R.A.E., where a vast amount of knowledge has been gleaned during various trials.

The installation of new types of equipment in Canberras, carried out by the company, has involved a considerable amount of test flying, and extensive flight tests have also been made on power-control operation. All manner of different power-control and pilots'-feel systems have been tested, and the information gathered has helped considerably in design for the future.

As can readily be seen, test flying for Boulton Paul during the last six years has not been exactly dull work. The reader may ask, what of the future? I can only seek refuge behind those black curtains with the warning notice.

The Cessna CH-1, not shown at Paris, has a nose-mounted 260 h.p. Continental engine.

Helicopters in Europe

FOURTEEN DIFFERENT TYPES SEEN AT PARIS

FOUR notable achievements in the helicopter world provided a background to the opening of the recent Paris Show. The first was the remarkable feat of the S.N.C.A.S.O. Djinn helicopter in landing at full load on the summit of the Jungfrau mountain in the Swiss Alps, a height of 13,669 feet. There followed, on June 6th, a landing by Jean Moine in a Bell 47-G2 on Mont Blanc, altitude 15,781 feet, now the highest recorded landing by a rotating wing aircraft. On the same day the S.N.C.A.S.E. pilot-engineer Jean Boulet climbed to a height of 8,260 metres (27,100 feet) in the new Alouette II, thereby establishing a new world altitude record for helicopters. Finally, on June 13th, the Bristol 173 twin-engined helicopter, flown by C. T. D. "Sox" Hosegood, succeeded in reducing the flight time for a non-stop helicopter flight from the centre of London to Le Bourget, Paris, to exactly 2 hours.

Those taking part in this London-to-Paris flight stressed afterwards that no special attempt had been made to set up a record time for the flight; it was just a cross-country flight at normal cruising speed. Nevertheless, much interest had been shown in the preparations for the Le Bourget visit and the machine was seen off from the South Bank by Mr. John Profumo, Parliamentary Secretary to the Ministry of Transport and Civil Aviation. Its average cruising speed for the journey was 112.5 m.p.h. The Bristol 173 arrived at Le Bourget in time to give a short demonstration before landing.

During the course of the week at Paris, the helicopters taking part in the display gave impressive performances amid the array of faster-than-sound fixed-wing prototypes; particularly so the little Djinn which was untiring in its efforts to give short passenger flights to the maximum number of people in the time available. In all, some fourteen different helicopter types were represented, a brief description of which is given here.

Alouette I and II Both machines, designed and manufactured by the S.N.C.A.S.E., were on view. Powered by the Turboméca Artouste II gas turbine, with a maximum rating of 400 h.p., the Alouette II incorporates many interesting new features. Rotor speed is controlled by an automatic fuel supply governor which obviates the need for a twist-grip throttle and the normal throttle/collective-pitch linkage. The cockpit control is a simple lever which increases or decreases the collective-pitch directly and also actuates the governor, thereby ensuring that the correct power supply is immediately and automatically available for any desired flight condition. The absence of clutch allows considerable simplification in the transmission system, from both design and maintenance points of view.

As a five-seater, at sea level, the Alouette II uses only 300 of the available 400 h.p., with the result that performance can be maintained at high altitude and in tropical conditions by using the excess power. Its weight-lifting capacity was ably demonstrated when one of the two machines flying lifted a small Citroen truck (weighing over half a ton) on an external sling and flew around with it at a height of 200 feet or thereabouts with apparent ease. Up to the present time five machines have been built and a production line is being planned.

Agusta-Bell 47G A production machine was flown into Le Bourget from Italy to take its place on the exhibition stand. Giovanni Agusta have delivered 40 model 47G's built under licence and their rate of production has now been stepped up to 8 machines per month. The price is 23 million lire, 13 million francs, or £13,000 sterling. The company is represented in France by Fenwick-Bell of Paris who operate a helicopter flying school at the old Aeroport de Paris and who are also representatives of the American corporation. The British representatives are Hordern-Richmond, Ltd.

Bell 47, G2 and 47H The latest Bell helicopter, the de-luxe three-seater 47H, powered by a Franklin engine of 200 h.p., has attracted much attention. The machine at Paris had been brought down on loan from its German owners, Hubschrauber Vertriebs G.M.B.H. but, unfortunately, was unable to fly because the formal German registration had not been completed. The internal fittings and finish are indisputably excellent and this helicopter sets a new high standard for a small executive communication vehicle.

The actual machine which had been landed on the summit of Mont Blanc, the Bell 47G2, powered by a 260 h.p. Lycoming engine de-rated to 200 h.p. was to be seen at Le Bourget. The use of a de-rated engine, the makers claim, increases considerably the engine overhaul life and also engine maintenance problems.

According to the pilot, Jean Moine, the mountain landing was made without difficulty, in spite of no little turbulence caused by a 20 knot wind, and there was a sufficient reserve of power, with a passenger aboard, to enable the machine to hover in the ground cushion in the normal way before touching down.

Bristol 171, 173 and 191 Being the only twin-engined helicopter displayed, the Bristol 173, with its new four-bladed rotors, also attracted much attention. A model of the Bristol 191 was displayed for the first time on the company's stand. This machine has been ordered in quantity for anti-submarine work and will be powered by two Leonides Major engines. The ubiquitous Sycamore, in the hands of Captain Peter Wilson, carried out a number of flights throughout the week. After the Salon, it went on to visit a German helicopter convention at Stuttgart organized by the German helicopter group, Studengemeinschaft fur Hubschrauber, and from there to Innsbruck, for mountain rescue demonstrations in the Austrian Tyrol.

Cessna CH-1 Although the actual machine was not present at the Cessna stand, information was available on this most recent newcomer to the helicopter scene. The Cessna CH-1, designed originally by Charles M. Seibel, is an all-metal machine powered by a 260 h.p. Continental engine. This is located forward in the nose so that the pilot and passengers occupy the space immediately below the centre of gravity. Outstanding performance figures are quoted by the manufacturers and it seems likely that this elegant machine, backed by the well-known light aircraft production experience of Cessna, will prove to be a worthy rival of its contemporaries.

S.N.C.A.S.O. Djinn A formation of six Djinns of the French Air Force provided an impressive sight in the official flying demonstration and one of these sturdy little helicopters, piloted by Colonel Fourcault of Helicop-Air, the French distributors, was flying throughout the week. The flying controls are strictly orthodox, compriaing stick, rudder pedals and collective-pitch lever with twist-grip throttle attached. As might be expected from its diminutive size, the Djinn is extremely light to handle and is highly manœuvrable, the asbestos-covered rudder operating in the efflux from the gas turbine being a most effective yawing control. While it is capable of performing a wide variety of commercial tasks, it will, undoubtedly, find its *forte* as a light and economical training helicopter. Availability on the civil market is expected by the summer of 1956 after existing military production commitments have been met.

For the first time, S.N.C.A.S.O. revealed a model of a new, and apparently large, single-rotor helicopter powered by twin turboprop engines carried on a high stub wing below the rotor

A Turboméca Artouste II gas turbine provides power for the S.N.C.A.S.E. Alouette II.

head. Conventional tail surfaces suggest that this machine will have some form of jet power applied to the blades for take-off and landing, and may cruise in a condition close to that of an autogyro.

Fairey Rotodyne The model on the Fairey stand does not change but, as the expected time for flight trials draws nearer, the interest shown in this machine progressively increases.

Hiller UH-12B A rotor head and gear box assembly were displayed on the Hiller stand as, also, were photographs of the ramjet driven Hiller Hornet and the new vertical riser designed by the company. Hiller machines are widely used throughout Europe on both civil and military applications.

Nord 1750 This machine is to be powered by a Turboméca Artouste II gas turbine, but no further details have been released by the S.N.C.A.N., the manufacturers. Results of flight trials are expected in the not too distant future.

Piasecki HUP-2 Nineteen HUP helicopters are operated by the French Navy at Toulon. A flying demonstration by one of them provided convincing proof of the maker's justly proud announcement that they have "planted their flag in Europe." During the 18 months the French Navy have been operating the Piasecki helicopters, they have completed over 4,000 flying hours and trained some 50 pilots.

The HUP is fitted with a modified Sperry A.12 Gyropilot and full blind flying equipment. Practice autorotational landings at night are a regular feature of the training programme. For rescue work and plane-guard duty, a hydraulic hoist enables a rescued man to be lifted up through an electrically-operated door in the floor of the cabin. It is of interest to note that an advanced version of the HUP-2 is in course of development which will be powered by a Wright R-1300 engine of 750 h.p. as distinct from the present Continental 525 h.p. engine. The new machine, to be known as the HUP-4, will have a considerably improved performance over the present HUP-2.

Sikorsky S-55 and S-58 For the first time, a model of the civil S-58 helicopter had been shown. Internal seating arrangements are for 12 passengers, carried on four bench-type seats, the two centre benches being placed back to back in the centre of the cabin. Access to the passenger compartment is by means of two wide sliding doors on the starboard side of the machine. That this machine is certainly a step in the right direction is clearly indicated by the cost figures from which it is apparent that the operating cost per ton/mile of the S-58 is only 58 per cent of that of the S-55.

Taking part in the flying display was a French-assembled WS-55 built under licence by the S.N.C.A.S.E. Up to the present time, 5 machines have been assembled by the company from imported American parts and 10 machines from imported British parts supplied by Westland Aircraft, but no local manufacture has yet been undertaken.

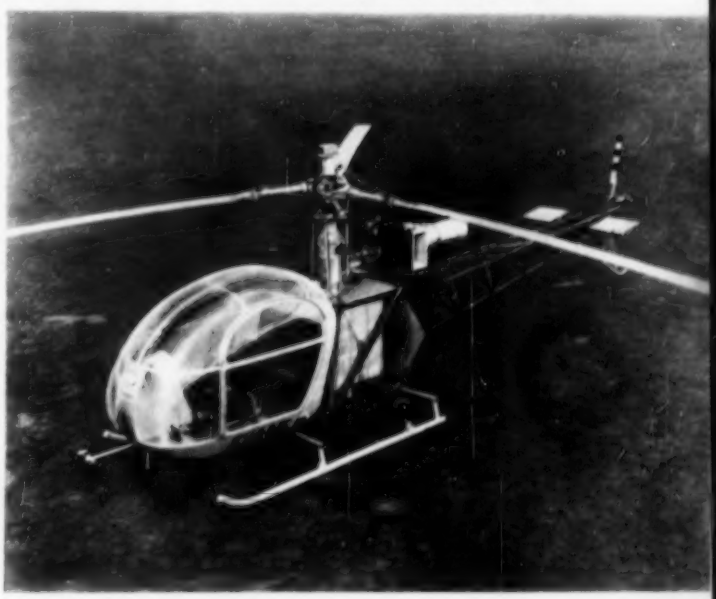
Skeeter 6 Vying with the Djinn to spend the greater time in the air throughout the week, the Skeeter 6, flown by Ken Reed, gave a number of remarkable demonstrations. The new 200 h.p. Gipsy Major engine, first demonstrated at Farnborough last year, gives it an excellent vertical climb performance and developments are on the way to increase the available power still further. A small production order was recently placed by the Ministry of Supply for this type.

DX-50 Simulator As an exhilarating conclusion to a most instructive week, the writer had the opportunity of operating the DX-50 helicopter flight simulator developed by Giravions Dorand. Much has been written on this subject recently but the attributes of the simulator have, in the writer's opinion, never really been shown up in their true value. Indeed, it would be difficult to appreciate from any written description just how excellent and faithful is the simulation of helicopter flight with this device. Even with only the cyclic-pitch control operative, as it is at present, it is difficult to realize, on switching off, that one has never moved from the starting point. When the collective-pitch and yawing controls have been added, the effect should be as near perfection as it is possible to achieve.

It will be remembered that it was by using this simulator that certain design modifications were made to the S.N.C.A.S.E. Alouette II, to improve its handling characteristics, before the prototype had ever flown. When it did make its first flights the actual helicopter needed practically no further modifications in this respect. Reproducing so faithfully, as it does, all those singular characteristics so well known to the helicopter pilot, the DX-50 simulator has, without doubt, a significant part to play in future helicopter development and flying training.

In addition to the helicopters themselves, helicopter engine manufacturers were well represented at the Salon, exhibits by Alvis, Curtiss-Wright, Napier, Turboméca, United Aircraft and others being included.

The Alouette II. Five machines of this type have now been built.



These sunny shots from Geneva's Cointrin Airport (before the international air display, reported in "Flight" last week) show, respectively, a visiting Convair B-36 with "anti-atom" white belly, and two Dassault Mystère IVAs in company with a Republic F-84F Thunderstreak.

AIRCRAFT INTELLIGENCE

Great Britain

Avro Vulcan. An Australian reader informs us—without comment—that on the morning of June 18th, Australian national daily papers printed an R.A.A.F. recruiting advertisement featuring a photograph of the Vulcan.

U.S.A.

Republic F-105. Several months ahead of schedule, the prototype of this supersonic fighter/bomber is due to check in at Edwards Air Force Base early this month for its first series of flight trials.

Boeing B-52. The initial cost of this bomber, production of which is being stepped up from ten to thirteen aircraft a month, is of the order of $10 million, and the overall operating costs for a wing (thirty machines) are estimated at $39,290,000 a year.

Fighter Production. General Nathan Twining stated recently that production of the U.S.A.F.'s supersonic fighter and fighter/bomber, the North American F-100 Super Sabre, is "at a satisfactory rate," and that the production of the all-weather Convair F-102 was also proceeding satisfactorily. Further acceleration did not, however, appear feasible at this time. The General added that it was both feasible and practical to step up production of the two new supersonic fighters, the McDonnell F-101 Voodoo and Lockheed F-104.

Convair XC-99. The world's largest transport aircraft, this passenger/freighter development of the B-36 is to start a 300,000 lb cargo air-lift from Dover, Delaware, to Iceland. The XC-99 is expected to move the entire 150 tons of cargo in five round trips, each scheduled at 34 hours, with a refuelling stop at Goose Bay.

Bell XH-40. This designation has been conferred upon the Bell Model 204 helicopter, winner of the U.S. Army utility-helicopter design competition. The machine is said by the makers to incorporate "several radical improvements" over all other helicopters of similar size and type. Planned duties are the front-line evacuation of wounded, general utility and instrument training. A Department of Defence announcement describes the machine as a lightweight closed-cabin single-rotor helicopter, capable of carrying at least 800 lb, of cruising at 100 kt, hovering at 6,000ft or more, and climbing at a rate of 1,500ft/min.

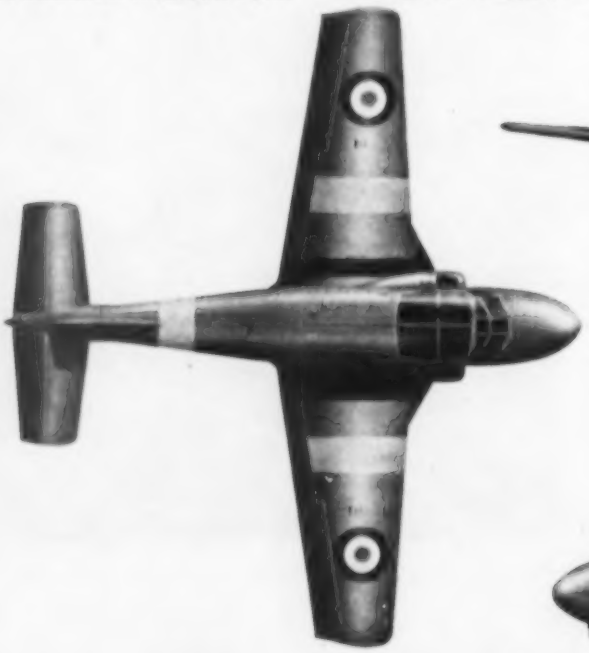
France

Bréguet 1050. An order has been placed with the Bréguet concern for the construction of five Bréguet 1050 anti-submarine aircraft for the French Navy. This type is powered with an Armstrong Siddeley Mamba or Rolls-Royce Dart, and is a development of the Types 960 and 965. A photograph of a model appeared in *Flight* of June 24th. A crew of three is specified. The main wheels retract into wing nacelles and a large radome is positioned under the fuselage. Top speed (engine unspecified) should be about 270 m.p.h., endurance 4 hours and ceiling 19,500ft.

S.E.210 Caravelle. Up to June 22nd, eighteen flights, amounting to 23 hours, had been made by this twin-Avon prototype transport.

Japan

Fuji LM-1. A derivative of the Fuji-Beech Mentor trainer, this four-seater is Japan's first post-war liaison aircraft. An order for about forty is expected within a few weeks from the Japanese Self-Defence Force. An additional tank is said to have extended the range to 860 nautical miles, and duties foreseen are light transport (up to 900 lb load); observation; ambulance work; photography; and dissemination of propaganda leaflets.



HUNTING PERCIVAL JET PROVOST T.1

(Armstrong Siddeley Viper 8)

Span	...	...	35ft 5in
Length	...	...	31ft 11in

REDUCTION of JET NOISE

Rolls-Royce Progress Surveyed: F. B. Greatrex's Anglo-American Lecture

IN a lecture entitled *Jet Noise*, presented at the Anglo-American Conference on June 22nd and summarized below, Mr. F. B. Greatrex describes recent progress in measuring and analysing jet noise, and discusses the results of a series of attempts to reduce it. The author is chief development engineer (installation division) of Rolls-Royce, Ltd., and his paper forms an interesting background to the announcement, earlier this month, that corrugated tail-pipe nozzles developed by that company had been found to give worthwhile noise-reduction without loss of thrust. Nozzles of this type are shortly to be air-tested by a Comet.

Mr. Greatrex introduced his paper by recalling some comparative measurements made in England about a year ago of the noise produced by four different civil aircraft (a Comet, a Constellation, a Stratocruiser and a Viscount) as they flew over a point one mile from the end of the runway after take-off and before landing. Fig. 1 (showing how the total noise varied during the few seconds immediately before and after the aircraft passed 500ft overhead during take-off, and also during an approach to land) illustrates how the noise from jet aircraft reaches a higher peak value during the take-off than that from the other aircraft and remains above a given annoyance level for a longer time. It is [the lecturer continued] this very loud noise, almost all produced by the turbulent mixing of the high velocity jet with the surrounding air, which forms the subject of this paper.

Noise tests on jet-engines. Nearly all the tests carried out by Rolls-Royce over the past two years had been performed on a special test-bed intended solely for noise measurements, having the engine centre-line 7ft 6in above the ground. The most comprehensive measurements have been made on an Avon engine [here their results were discussed in some detail by the lecturer].

Measurements made some time ago on a Derwent showed that there was no significant difference in the jet noise produced by a small centrifugal engine and by a larger axial engine.

But the Conway engine [the lecturer continued] is of the bypass type in which some of the low pressure air by-passes the combustion chamber and turbine and rejoins the hot gas stream in the jet-pipe: the jet temperature is therefore lower than that of a normal jet-engine of the same thrust, and consequently the velocity is also lower and the mass flow, and jet diameter, correspondingly higher. Since jet noise increases as the eighth (or even higher) power of the velocity, the noise of such a bypass type of engine should be very considerably less than that of a normal jet-engine.

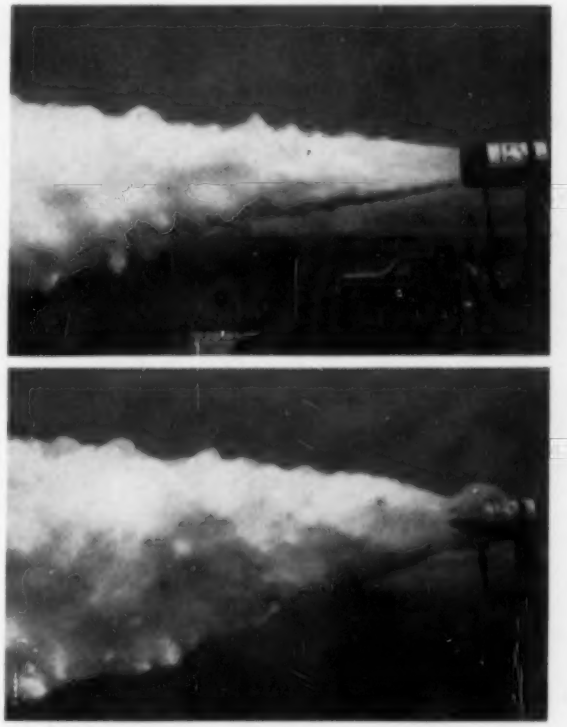


Fig. 2. Comparison of jet "spread" from a conventional (top) and a toothed nozzle. Oil sprayed into the jet makes it visible.

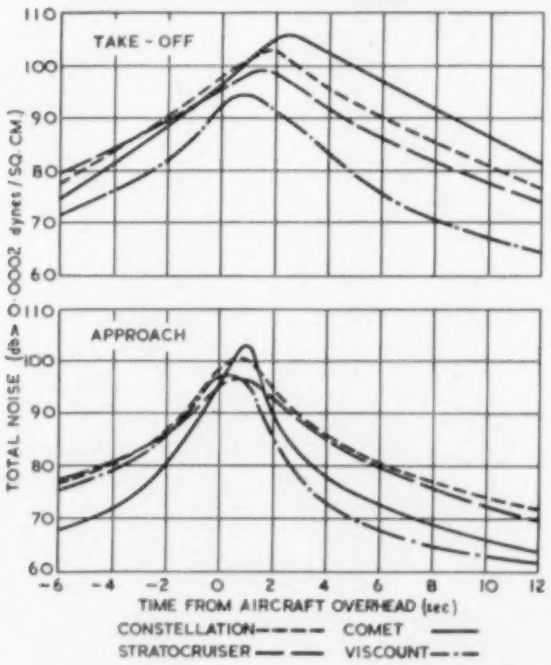


Fig. 1. "Time variation" measurements made with four types of commercial aircraft on take-off (top) and approach.

This simple fact has been verified by a direct comparison of the total noise levels measured at 50ft radius for a Conway and an Avon engine developing the same thrust. The comparison was made at two different thrust ratings, corresponding approximately to take-off and maximum continuous cruise ratings, and in each case the Conway was quieter by some 8 to 10 db. The exact value of this difference may be slightly in doubt, since for this test the Conway was on the open-air test-bed whereas the Avon was in an aircraft and consequently nearer to the ground, but it is clear that the Conway is very much quieter.

Noise reduction devices. The first device that showed any promise in a full scale test was the toothed nozzle originally tested on a model scale by Lilley at Cranfield. On a Derwent engine it was found to alter the noise distribution pattern such that the relatively low-frequency noise at small angles to the jet axis was reduced, but the high-frequency noise at large angles was increased. This characteristic is valuable in that the high frequencies are far more easily attenuated, and was worth examining more thoroughly.

The measurements have therefore been repeated on the Avon engine on the open-air test bed, in very much greater detail, with substantially the same results as described above.

Calculations of the total acoustic power output showed that there was an increase of 4½ db compared with the conical nozzle at 1,300 ft/sec jet velocity, and ½ db at 1,800 ft/sec. These results agree reasonably well with recent measurements made by the N.A.C.A. at Cleveland.

Unfortunately on the Avon engine the "teeth" had a serious effect on engine performance, reducing the thrust and increasing the specific consumption by 2 per cent (on the Derwent engine

REDUCTION OF JET NOISE . . .

Fig. 3. (Left) Noise-reduction levels achieved with an Avon, using varying numbers of 2.65in corrugations.

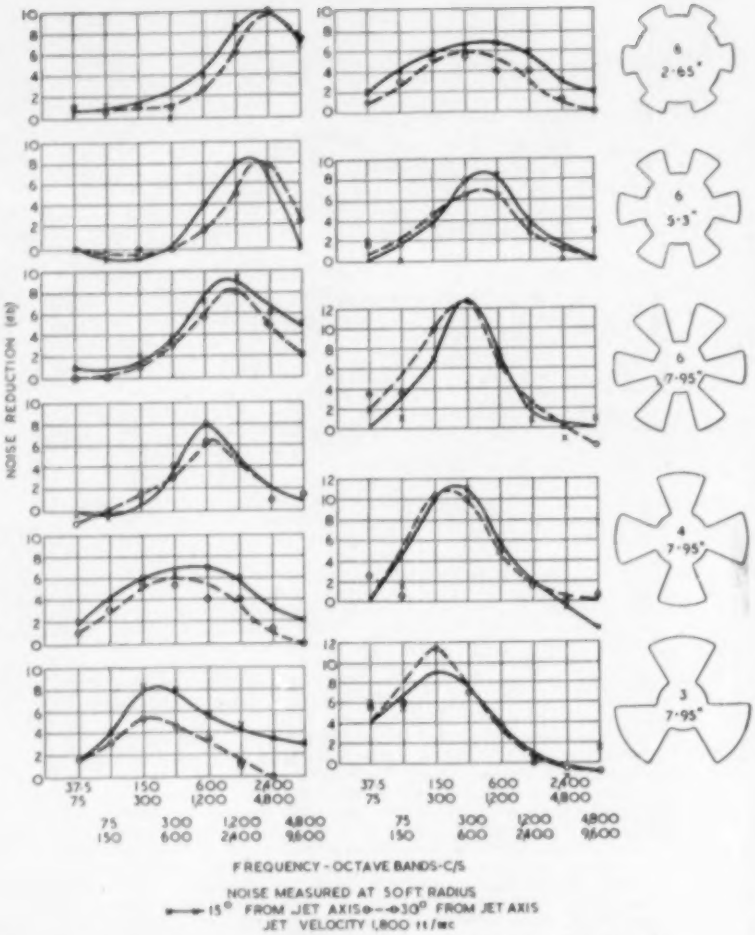


Fig. 4. (Right) Results achieved with a second set of nozzles, using deeper corrugations. The number and depth of corrugations is shown in each case.

the effect was negligible). These performance losses are of course higher than can be tolerated, and the toothed nozzle has been abandoned as a noise reduction device.

It is still of interest, however, to discuss the mechanism whereby the "teeth" affected the noise. One obvious characteristic of the jet from the toothed nozzle is its much greater angle of spread; this can be seen very clearly in the photographs of Fig 2, in which oil has been sprayed into the jet-pipe some distance upstream of the nozzle in order to make the jet visible—(a useful technique for a quick examination of the effect of changes in nozzle shape). This increased angle of spread implies a more rapid mixing of the jet and the air, which is presumably associated with a general reduction in the noise generated. On the other hand the teeth themselves produce a large number of (relatively) small eddies which presumably add sufficiently to the high frequency noise to raise it above the original level. The combination of these two effects would produce the measured results.

This clue of the advantages of rapid mixing led to an attempt to reproduce the same effect, by greatly increasing the perimeter of the nozzle, without affecting engine performance. The first of the "corrugated" nozzles shown in Fig. 3 was made for the Avon engine, and the first satisfactory result was that a test-bed run showed that it had no effect whatever on the engine performance. And it produced a marked reduction in noise, as much as 10 db, but only at the highest frequencies.

It was an obvious step to link this high frequency effect with the small spacing of the corrugations, and to try the effect of increasing this spacing, reducing the number of corrugations. A whole series of these corrugated nozzles was therefore made and tested with the very striking results shown in the figure. The peak value of the attenuation is slightly reduced with the smaller number of corrugations, but the frequency at which this peak occurs is reduced almost directly in proportion.

Now the highest noise levels from a jet-engine are mainly in the neighbourhood of the 300-600 c/s octave band, so that the nozzle with six corrugations, giving a reasonable attenuation over the frequency range from 150-2,400 c/s is clearly the most useful out of this range of nozzles. Measurements made with this nozzle showed that, apart from attenuation of the middle frequencies, the contours for each octave band are very little different from those with a standard conical nozzle; the total noise contours show the angle of maximum radiation to be rather larger, as would be expected, since it consists mainly of noise of higher frequency. At no point in the field is the noise significantly increased, so that in this case there is a definite overall reduction in the acoustic power output. At the top end of the scale, in fact, the corrugated nozzle produces a reduction of about 4 db in the total acoustic power output.

The next step was to experiment with deeper corrugations. The original series of corrugated nozzles all had a depth of corrugation of 2.65in extending 1.25in above and 1.4in below the 19.5in diameter of the circular nozzle of the same area. A six-corrugation nozzle of twice the depth of corrugation, i.e., 5.3in was therefore made, and found to give attenuations of 1 to 12 db, but also a reduction in thrust of nearly 2 per cent. This was due to this nozzle being of the same length as the original one, and consequently the angle of convergence of the inner walls of the corrugations was too great. Another nozzle of twice the length was made and the thrust loss disappeared. In all further tests on corrugated nozzles, therefore, the angle of convergence of the inner walls was limited to 12 deg.

Unfortunately, most of this extra attenuation was also lost with this lengthened nozzle, but a further increase in depth of corrugation to 7.95in produced peak attenuations of over 12 db, still without any effect on engine performance. The results are shown in Fig. 4 compared with those for the original nozzle with six corrugations.

It seemed that the "aspect ratio" of the corrugations of this last nozzle was such that the air flow into the bottom of the corrugations would be seriously restricted, and the next two nozzles of Fig 4 were therefore tested. These had the same depth of corrugation, but only four and three corrugations respectively. The results show the same sort of reduction in peak attenuation frequency as was found in the original series of nozzles, but the amount of attenuation was slightly reduced.

However, the amount of attenuation has been found to depend on the depth of corrugation for both the six-corrugation and the four-corrugation nozzle, so the next step is obviously to take the depth to its limit, and nozzles of the shapes shown in Fig. 4A will be made and tested.

Noise reduction mechanism. Lighthill's theory gives a very satisfactory general account of the mechanism of noise generation by a jet, but in order to understand the selective effect of these

Fig. 4A. Two nozzle configurations yet to be tested and (right) a perspective sketch of a nozzle with ten corrugations.

corrugated nozzles some further information is needed, particularly on the distribution of noise along the jet. The following very simplified analysis seems to give a crude picture of this distribution which lines up with known facts.

Fig. 5(a) illustrates diagrammatically the spread of a jet from a circular nozzle. The shaded portion represents the core of uniform velocity which persists for about five diameters downstream of the nozzle; the outer lines represent the edge of the jet spreading at an angle of about 15 deg (total included cone angle). The mixing region in which the noise is generated lies between the edge of the jet and the core, or further downstream between the edge and the centre of the jet.

In Fig. 5(b) the peak velocity in the jet has been plotted against the distance down the jet, and in Fig. 5(c) the area of the mixing region. Now if the assumption is made that the noise generated at any station down the jet is a function of the area of the mixing region and the peak velocity *at that station* (neglecting the density term, since the mean density is constant over the length of the core and only varies very slowly downstream of it), then the noise energy variation down the jet is shown in Fig. 5(d) (using the eighth power law of Lighthill's original theory). Furthermore, it is reasonable to assume that the frequency associated with the noise at any station is a function of a typical velocity divided by a typical length at that station; Fig. 5(e) therefore shows the variation of (peak velocity/width of mixing region) down the jet.

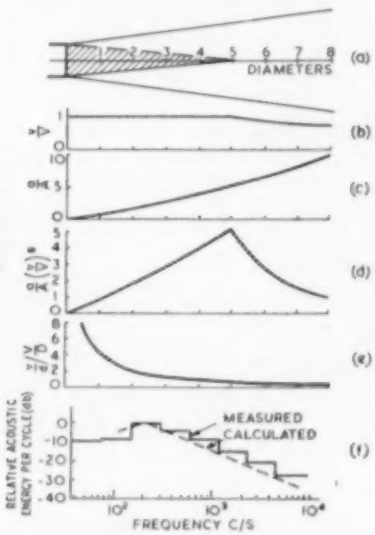


Fig. 5. Variation of noise energy and frequency estimated from known velocity and area variations in a jet. Symbols used are: v, peak velocity; V, initial velocity; a, area of mixing region; A, nozzle area; d, width of mixing region; D, nozzle diameter.

Substituting the appropriate values of V and D for the Avon, and putting in an entirely arbitrary constant to give frequency = $\frac{1}{4}\frac{v}{d}$, the curves of Fig. 5(d) and 5(e) have been replotted in Fig. 5(f) as relative noise energy per cycle against frequency, and compared with the measured results obtained over the usual eight octave bands on the Avon.

According to this very crude picture of the noise generation the noise level increases from the highest frequencies near the nozzle to those frequencies corresponding to the peak noise at the end of the core, solely due to the increase in area of the mixing region, and then falls off at lower frequencies due to the reduction in the peak velocity at the centre of the jet. This picture is no doubt grossly over-simplified, since it uses the final formula of Lighthill's theory and ignores entirely its shear and turbulence derivation, but it does give some sort of quantitative explanation of the experimentally observed facts.

Referring back to Fig. 4, does this picture of the noise distribution give any clue to the behaviour of the corrugated nozzles? In a very crude manner it does, on the following argument:—

The effect of the corrugated nozzle is to increase considerably the initial mixing, and hence the mean angle of spread of the jet, until the "corrugations" disappear and the jet becomes circular again; from this point onwards the jet will spread in the same manner as one that was originally circular. Over the first part of this process the noise energy-frequency relationship will not be affected since the distance down the jet does not appear in this relationship, and similarly downstream of this point there will be little change. At the actual transition point, however, a high rate of mixing has to die down to a lower rate of mixing; and some reduction of the noise generated in this region might be expected.

Practical problems. There are three main conditions under which the noise needs to be examined more fully: from engines being run on the ground, from aircraft passing overhead during take-off and approach, and as experienced by the passenger inside the aircraft. This paper is concerned only with the noise from jet engines as installed in aircraft; silencing of engine test-cells is assumed to be no longer a problem.

[Under the heading of noise from ground-running of engines, the lecturer discussed the results achieved with the type of acoustic pen described in *Flight* for October 8th, 1954, continuing as follows:—]

Clearly the expenditure of about £10,000 on a pen of this sort is a complete solution to the problem of noise from ground running engines of a single-engined aircraft, provided that the inconveniences of moving the aircraft in and out of the pen are accepted. For multi-engined aircraft the cost will of course be greater, but on the other hand there is less likelihood of having to cater for afterburning.

In general, noise from aircraft during take-off and approach is a serious problem only in the neighbourhood of civil airports, not military airfields with their much less frequent aircraft movements. To obtain some idea of the magnitude of this problem the series of tests mentioned at the beginning of this paper were carried out.

The maximum values of total noise for the various aircraft during take-off are as follows:—

	db
Comet	106
Constellation	102.5
Stratocruiser	99
Viscount	94

This is not strictly a fair comparison of the different types of engine, since the aircraft sizes and engine powers vary very widely. If the figures are all corrected to the same all-up weight as the Comet on the reasonable assumptions that noise is proportional to power, and that engine powers will vary in proportion to all-up weight, then the Stratocruiser and the Viscount give nearly the same result, and the table of maximum noise levels during take-off becomes as follows:—

	db
Jet-engined aircraft	106
Propeller-engined aircraft:—	
With exhaust noise	102.5
Without exhaust noise	97

The curves obtained during the approach tests showed that the predominating noise from the Comet was the high-frequency noise from the compressors, which is audible above the jet roar only at these very low (relative) jet velocities. If the maximum values of total noise are corrected to the same aircraft all-up weight in the same way as before, and to the same 500ft height as during the take-off tests by the inverse square law, then the Comet comes out rather noisier than the other three aircraft, which are all within $\pm\frac{1}{2}$ db of each other. The resulting comparison of maximum noise levels during approach is as follows:—

	db
Jet-engined aircraft	97.5
Propeller-engined aircraft	94.5

The conclusion to be drawn from these tests is that the noise from a jet-engined aircraft will be about 9 db higher during take-off but no worse during the approach than the worst noise from a quiet piston-engined aircraft of the same all-up weight. If the latter can be operated without too much disturbance to residents in the neighbourhood of the airport, but only just, then the present noise level from jet-engines during take-off must be reduced by about 9 db for satisfactory civil operation.

How can this be achieved? Not of course just by throttling back to $\frac{1}{4}$ power and using up the engine-failure safety margins as has been seriously suggested. Obviously the use of a bypass engine such as the Conway should give the required result; by the use of devices such as corrugated nozzles it should be possible to bring the noise from the ordinary jet engine down to the desired level, and from the bypass engine to a lower level still.

Incidentally, it should now be possible to calculate the noise from a jet-engined aircraft under conditions such as during take-off from the basic data which is becoming available on jet noise.

Regarding noise inside aircraft, it seems therefore that the take-off case is the only serious one to the passenger. It is probable that he will be prepared to tolerate this noise, provided (as will be the case) that the aircraft is quiet for the remainder of the flight. However, if it is necessary to alleviate it, a lot can be done by suitable design of the aircraft lay-out to avoid the high intensity regions of the noise field, now that reasonably full information on this is becoming available. Noise reductions can of course also be obtained by the use of quiet types of engine and nozzle.

No mention has yet been made in this paper of the structural fatigue problems associated with jet-noise, but this is not for lack of awareness of its importance. Precisely the same arguments just used apply to this problem also—it is only serious under ground running and take-off conditions, and it will be necessary to design the aircraft and use suitable engines and nozzles in such a way as to avoid trouble.

REDUCTION OF JET NOISE . . .

Conclusions. (1) The high velocity jet from a jet-engine is evidently a very powerful source of noise, capable of disturbing the peace of large numbers of people. However, its characteristics are becoming known, and some means of reducing its intensity have been found.

(2) These will make the noise from civil aircraft tolerable, at least to the extent that the noise from jet-engined aircraft will be no worse than that from propeller-engined aircraft of the same all-up weight. On the other hand it is doubtful if the noise from military aircraft using afterburning in flight will ever be reduced to the same level, though it will of course have to be tolerated for the sake of its military necessity. Fortunately the noise from prolonged ground-running can be effectively silenced, even when afterburning is used, at a not-unreasonable cost.

(3) The passenger in the jet-engined airliner is unlikely to be greatly affected by jet-noise, since it is only troublesome at take-off, but both the noise and its associated structural fatigue problems will have to be considered in the design of the aircraft.

These conclusions refer strictly to the present generation of jet engines. The use of engines of very much greater thrust, or the widespread adoption of rocket engines for example, will raise new problems, and further research into methods of control will therefore be needed to keep pace with increases in noise produced.

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

Gloster Gladiator Collector Ring Wanted

WITH the air display season fast getting into its stride, we are regularly being asked to demonstrate our Gladiator at various places all over the country.

We have unfortunately had to refuse the majority of these invitations due to unserviceability of the aeroplane caused by a completely worn out exhaust collector ring.

If any of your readers are able to advise us of the whereabouts of one of these Mercury 8 collector rings, part numbered FD.53906, Stores Reference 36/R/31275 or 67490, which will enable us to keep this gallant old warrior in the air, we and many hundreds of aviation enthusiasts will be extremely grateful.

Gloster Aircraft Co., Ltd., Gloucester. E. S. GREENWOOD.

History and Secrecy

YOUR correspondent who is making enquiries into the early activities of J. W. Dunne may like to read the illustrated article in *Flight* for September 3rd, 1910. When he has completed his history of Capt. Dunne's work I am sure that many of your readers would like the opportunity to learn about it.

If your correspondent is interested in the history of aviation in general he may like to know that, as the result of some recent "delving", I discovered that the true date of the death of Horatio Phillips was July 15th, 1924. Reference books give the date as some time in 1912. Another interesting fact is that his wife (I believe he married twice) is still alive.

Hounslow, Middx. H. COWLEY.

Why are we Waiting?

IN your leader "Why are we Waiting?" (June 24th), you ask why must the airlines, including B.O.A.C., fail to tell their passengers the reasons for delays in departures immediately it is known that one will occur.

I should point out that in B.O.A.C. it is our practice to inform passengers at once if there is to be a delay and at the same time to explain that it is due to weather, or technical reasons, and so forth. Clearly, it is not always possible to tell them outright the precise cause of any technical trouble as often this is unknown until the engineering staff have made an investigation—but there is no question of keeping passengers "in the dark."

B.O.A.C., Piccadilly. F. C. GILLMAN,
Chief Press and Information Officer.

IN your Editorial of the 24th, you refer to unexplained delays in various forms of transport, and say that "the shipping companies are usually quite good on this score." I wonder whether the grass is always as green as it may seem on the other side of the hill and does not, at least in this case, turn out to be weeds.

There is of course a popular superstition in aviation circles that ships are slow and reliable things, running to a precise time-table with unfailing mechanical reliability, so I should like to recite what actually happened to me last September.

I planned to take my car to Gibraltar and tour back to a Channel port, making seven or eight night-stops intermediately, at most of which reservations had to be booked. Three days before the ship was due to sail, I heard purely by chance that sailing was delayed two days because of a dock strike, so telegrams had to be sent off re-aligning the hotel bookings. At Tilbury there was no proper waiting room and passengers had to stand about for over an hour before the gates into the Customs building were opened. On board, no cigarettes—even those on which duty had been paid—could be bought until the following morning. Just after dinner there was a jolt followed by a graunching noise as one of the main engine connecting rods flew through the side of the crankcase. For the next 14 hours we chugged along on one engine at 10 knots until the starboard power unit had been converted from a nine to an eight cylinder engine. This made us a further half-day late at Gibraltar.

By all means let us improve air transport, reduce delays and explain those which cannot be avoided. But we must set our own pace, and ignore the standards of the last century which still cling tenaciously to the means of transport then invented, and whose protagonists have not yet understood the impact of air competition.

Royal Aero Club, Piccadilly. JOHN GRIERSON.

A.E.F. Airplane Procurement

E. I. ZAHN's interesting list of British-built aircraft for the A.E.F. is substantially correct. The full list is given in J. C. Fahey's *U.S. Army Aircraft, 1908-1946*. 143 (not 140) Sopwith F.1 Camels and 52 (not 50) Avro 504Ks were supplied, and, in addition, two D.H.9s were procured without engines—Liberty 12A's being fitted later. Of the 282 British aircraft bought 258 were delivered by the armistice.

The A.E.F. also received 1,440 American-built D.H.4s, two Lusac-11's got to France, and parts for 100 Handley-Page bombers got to England. U.S. personnel serving in Italy operated Italian-owned planes, but also bought 19 S.I.A. 7B-I trainers.

From France the A.E.F. procured 5,029 aircraft (4,881 delivered by the armistice), of which 514 were Sopwith 1½-Strutters built in France under licence. Many A.E.F. Sqns. were equipped with French aircraft, at the armistice it had two Sqns. of Bréguet 14, ten of Salmson 2-A-2 and 16 of Spad XIII.

Malvern, Worcester. R. MEREDITH.

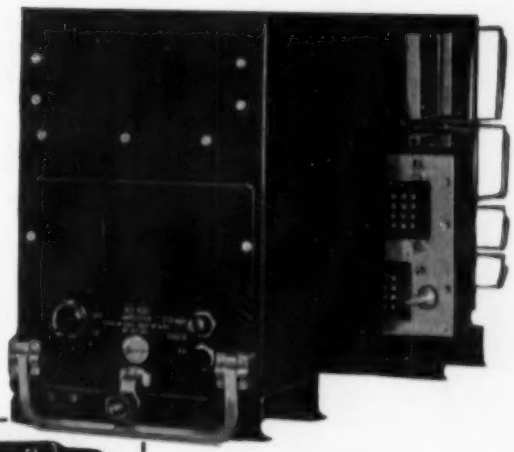
IN BRIEF

Junior Technician I. A. Bremner has chosen *Production and Handling of Compressed Gases* as one of the specialist subjects necessary for his promotion examination. He is unable to obtain the relevant Air Publications and would be grateful to any reader who would be kind enough to led him suitable notes for copying. His address is: A.S.F. 238 O.C.U., R.A.F. Colerne, Chippenham, Wilts.

FORTHCOMING EVENTS

July 2. Elstree Flying Club: At home.
July 2. R.N.A.S. Arbroath, Angus, Scotland: Air Day.
July 2-4. R.Ae.C.: Members' La Baule rally.
July 3. Fair Oaks Aero Club: At home.
July 4. R.Ae.S. Halton Branch: "The Medical Aspects of Aircraft Engineering," by W/C. Latham.
July 7-10. Pescara Aero Club: Third Annunzio Trophy meeting.
July 7-9. Royal Aircraft Establishment, Farnborough: 50th Anniversary Celebrations.
July 9-11. Livorno Aero Club: Air Rally.
July 9. R.N.A.S. Lee-on-Solent and Gosport (combined), Hants: Air Day.
July 9-11. R.Ae.C.: Members' Deauville rally.
July 16-17. Trento Aero Club: Eighth international rally.
July 20-24. Venice: Fifth International Aeronautical Exhibition.
July 23. R.N.A.S. Brawdy, Pembrokeshire: Air Day.
July 23. R.N.A.S. Ford, Sussex: Air Day.
July 23-24. Alessandria Aero Club: Air rally.
July 23-Aug. 1. National Gliding Championships: Lasham.
July 24. Vintage Aeroplane Club: Garden Party.
Aug. 15-26. Commonwealth Survey Officers' Conference: Cambridge University.
Aug. 19-20. R.Ae.C.: Fourth National Air Races meeting and Lockheed aerobatic trophy competition, Coventry.
Aug. 21. Northamptonshire Aero Club: At home.
Aug. 27. R.N.A.S. Anthorn, Cumberland: Air Day.
Sept. 3. Leicestershire Aero Club: Air display.
Sept. 5-11. S.B.A.C. Show, Farnborough.
Sept. 12-18. Battle of Britain week.
Dec. 16. London Airport inauguration by H.M. the Queen.

Aircraft Intercommunication



MARCONI EQUIPMENT TYPE AD 401 PROVIDES...

Intercommunication between up to ten positions in the aircraft and connection of mic/tel handsets for ground servicing crews.

Connection for nine services: four transmitter/receivers and five receivers or navigational aids.

Simultaneous mixing of four channels each having its own volume control: intercommunication plus three selected services.

Above is the amplifier unit and the junction unit which serves as the backplate for the mounting rack of the amplifier unit, and thus eliminates cable connections between these two units. A main station box is shown on the left.

Features

- Self-contained power unit housed in amplifier unit.
- Detachable chassis arrangement and robust construction for ease in servicing.
- Lamp signalling between all station boxes.
- Emergency override facilities.

A minor station box is shown above. All units are designed to fit standard aircraft racking and for easy access in servicing.

More than forty Airlines and twenty Air Forces fit Marconi air radio equipment. Marconi airport installations are in use throughout the world.

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Airport and Aircraft Radio Systems

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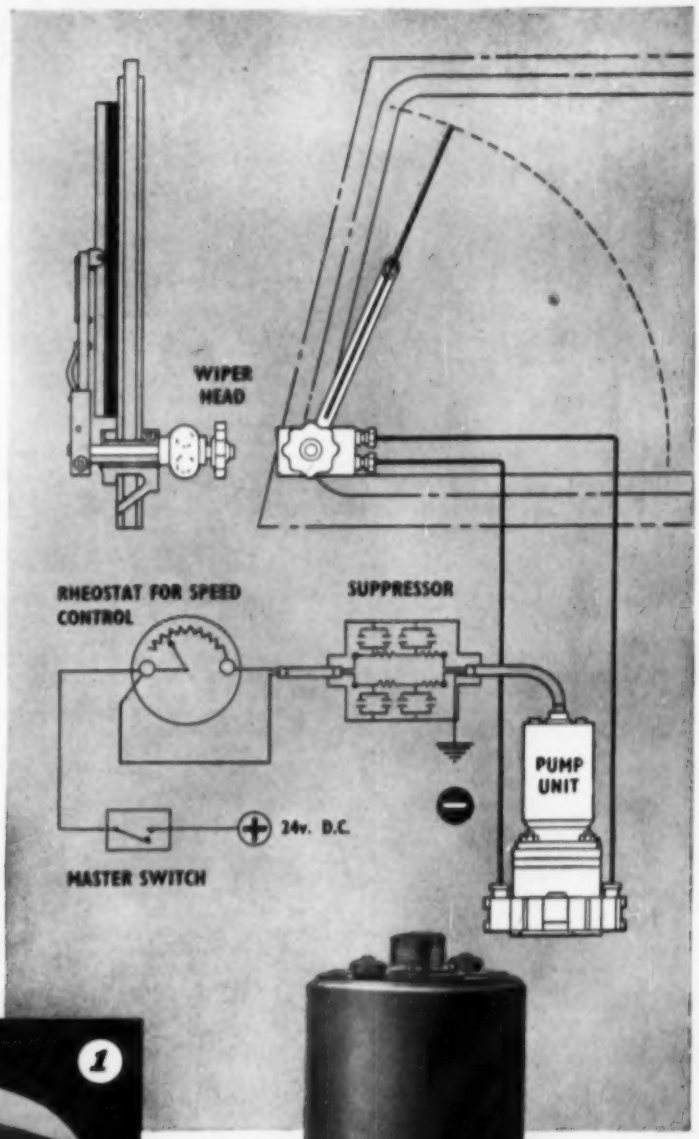
Partners in progress with The **'ENGLISH ELECTRIC'** *Company Limited*

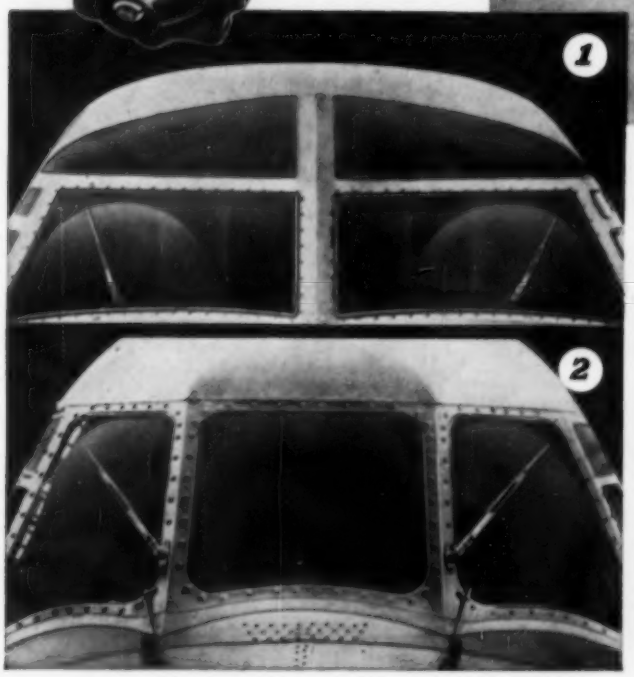
LA 9

DUNLOP
'MAXIVUE'
Wiper Systems give
maximum visibility for
bad weather landings

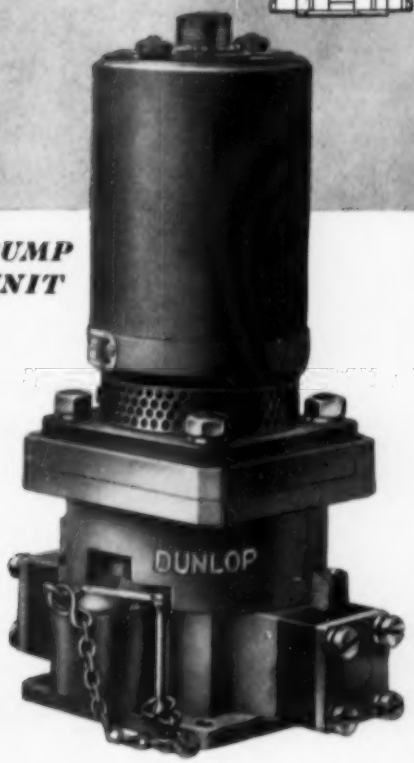
Small, compact, with hydraulic transmission, the 'Maxivue' offers the least interference to the forward view. The essential simplicity of the system is emphasised in the diagram.
All the components can be mounted within the cockpit with complete safety, the amount of fluid under pressure being negligible.
Typical illustrations shown below are
1. Universal Freighter.
2. Viscount.



WIPER HEAD



PUMP UNIT



Congratulations to Boulton Paul on their 40th anniversary

ROTAX are proud to have been suppliers of electrical equipment for the Boulton Paul Company.

We look forward to the continuance of our long association with Boulton Paul.

ROTAX LTD., WILLESDEN JUNCTION, N.W.10.

LUCAS-ROTAX (AUSTRALIA) PTY. LTD., MELBOURNE & SYDNEY, AUSTRALIA

LUCAS-ROTAX LTD., SCARBOROUGH, ONTARIO, CANADA.

CIVIL AVIATION

The almost-completed Handley Page Herald prototype as it appeared after the "unveiling" at Woodley on June 29th. Four Alvis Leonides Major engines are in place, though the de Havilland airscrews have yet to be added, together with some minor airframe details.

FIRST HERALD NEARS COMPLETION

ESSENTIALLY complete and only a few weeks away from its maiden flight, the first of two prototype Heralds was "unveiled" on June 29th at Woodley, where the aircraft was designed and will be produced by Handley Page (Reading), Ltd.

Introducing the Herald, Sir Frederick Handley Page said that it represented his company's attempt to provide the airlines with a "workhorse"—an aeroplane to go from point A to point B with security and regularity and at an economic price. They had tried not to be obsessed by the glamour of going at tremendously high speeds, for, Sir Frederick said—and here he re-echoed a sentiment expressed by the Duke of Edinburgh in the latter's memorable lecture on *Outback Aviation*—"if your only competitor is an ox wagon you do not need to go through the sound barrier to convince your potential passengers that it's better to go by air."

Handley Page's sales manager, G/C. R. C. M. Collard, stressed that while the Herald was intended to do work now done by DC-3s it should not be looked upon simply from a European standpoint—"in Europe practically nobody flies (of course, they fill the seats, but they are roughly the same people all the time)." The aircraft should be considered from the point of view of "the advanced air-minded Peruvian Indian rather than a pedestrian and largely earth-bound European." The Herald was a branch-liner, and Handley Page had found ample evidence that the branch-line operators as a whole felt that the aeroplane made sense.

Speaking for Alvis, Ltd., makers of the Herald's four Leonides Major piston engines, Mr. T. C. Wallace said his company were conscious of the problems faced by an aircraft constructor offering a new aircraft with new engines—of which operators were invariably suspicious. But Alvis did not think of the Major as new; it was a "bigger and better Leonides", having the same bore and stroke, and essentially similar pistons, cylinders and valve arrangements, as the smaller engine. Leonides serving with Flying Training Command alone had built up one million "cylinder hours"—a big advantage in the development of the Major, since the cylinder assembly was always one of the slow features. The Major, which had now completed some 50 hours' flying in the H.P.R.5 Marathon twin-engined test bed, had the remarkably low diameter of 38.9in. Translated into frontal area in a four-engined aeroplane, that meant 22.4 sq ft less than its nearest competitor.

Summing up for the Handley Page Board of directors, A. Cdre. A. V. Harvey paid tribute to the team who had built the Herald prototype "in just about twelve months," and introduced some of its senior members: Mr. G. R. Volkert, technical director; Mr. E. W. Pickston, manager; Mr. E. W. J. Gray, chief designer; Mr. J. Allen, assistant chief designer; and G/C. A. F. Bandidt, assistant sales manager.

"Bush" Bandidt, incidentally, has been appointed Handley Page representative for Australia, New Zealand and the Far East. From the autumn of this year he will be based in his native Australia (at Melbourne). As the personal envoy of Sir Frederick Handley Page, G/C. Bandidt has in recent years travelled far and wide to conduct a sales-cum-market-research survey of the requirements of most of the world's short-haul airlines. The Herald is based on his findings.

The prototype, which it is hoped will fly next month (and is thus a likely starter for Farnborough) has been built with unusual speed. This programme to date is outlined by the manufacturers as follows:—

"Although a small project team began work on the Herald concept late in 1952, it was not until last year that detailed design of the aircraft began. . . Design of the fuselage aft-portion started in August of last year, of the centre-portion in September and of the nose-portion and centre wing in November. Work on inboard nacelles began last January, on the fin in February, on the flaps and outboard nacelles in March, on the rudder, tailplane, outer wings and petal cowlings for the engines in May, and on the elevators and ailerons during the past three or four weeks. Component assembly of the prototype started only in December 1954. In six months it has been completed, apart from a few small details."

Orders have been placed by three airlines for a total of 29 Heralds. The customers have been named as Australian National Airways, Queensland Airlines and Lloyd Aero Colombiano, though the actual numbers ordered by each have not been revealed.

One's first impression of the Herald is that it certainly possesses the qualities of spacious, sensible layout and robust construction so essential for "outback" operation. Access to the moderately pressurized cabin (3.35 lb differential) is by way of a large double loading door, one half of which may be kept closed—or omitted at the operator's discretion. The low-set floor is fully stressed for cargo, and a non-structural bulkhead may be so positioned to give a choice of passenger-freight combination loads. The special lightweight 9g double seat designed for the Herald will pick up at two points—one in the floor and the other on the cabin wall. Seats can be pitched at 33½in or 38in, giving maximum passenger capacities of 44 or 36 respectively in an all-passenger version. The flight deck, laid out for two-crew operation and at present based on B.E.A./B.O.A.C. recommendations, is extremely compact and offers excellent forward visibility from either seat.

Structurally, the Herald has several extremely interesting features, including the extensive use made of spot-welding—notably for joining fuselage skin to stringers. The wing has been designed for a long fatigue life and has no heavy spar booms; bending- and end-loads are carried by the sandwich skin panels of the centre-section, which has three lightly loaded web members to take shear loads. The method of attaching outer wings to centre-section is reminiscent of DC-3 practice, in that "a multiplicity of bolts" are employed.

LORD BALFOUR JOINS B.E.A. BOARD

THE appointment of Lord Balfour of Inchrye, M.C., as a part-time member of the Board of British European Airways, effective from July 1st, is announced by the M.T.C.A. Lord Balfour, who is 57, served with the R.F.C., and later the R.A.F., from 1915-23. He was Parliamentary Under-Secretary for Air from 1938-44.

PANAM'S 50,000th

THE Pan American World Airways DC-7B which, on June 28th-29th, made the airline's 50,000th crossing of the Atlantic, arrived at Orly, Paris, 10 min ahead of schedule. Carrying 67 tourist passengers, it covered the 3,625 miles from New York non-stop in 10 hr 50 min at an average speed of 335 m.p.h. The aircraft was one of seven DC-7Bs now entering service with PanAm (and illustrated for the first time on page 63).

Celebrations marking the 50,000th crossing included a reception at the airline's Piccadilly, London, office, where a guest of honour was Capt. Charles Blair, one of PanAm's Stratocruiser captains on the North Atlantic. Capt. Blair has more transatlantic flights to his credit than any other pilot, having crossed the ocean 628 times. His flying hours total over 21,500.

LEOPOLDVILLE'S LONG RUNWAY

CLAIMED by Sabena, its main users, to be "without doubt the longest in the world," a new runway of 15,420ft—nearly three miles—has recently been completed at Leopoldville, capital of the Belgian Congo. Previously, say Sabena, the longest runway was that at the American military base of Ben Guerir, Morocco (14,000ft), and the longest civil runway—13,100ft—was at Honolulu. Some of the longest of European civil runways are at Barajas, Madrid (10,006ft); London (9,570ft); Kloten, Zurich (8,520ft); Melsbroek, Brussels (8,040ft); and Schiphol, Amsterdam (7,050ft).

The very smart Heron 1 pictured here at Speke Airport, Liverpool, is G-ANCI, first of a fleet ordered by Dragon Airways. The occasion was the inaugural departure, on June 28th, of the company's scheduled service to Renfrew, Glasgow, which operates four days weekly in each direction. The service was formerly flown with Rapides.

CIVIL AVIATION . . .

SWEDISH HELICOPTER SERVICES

SCHEDULED helicopter services were introduced by Ostermans Aero, of Sweden, on June 17th on a short route linking Denmark with Sweden. Services, operated twelve times daily in each direction with an eight-seat S-55, are between Copenhagen and Malmo. Most of these flights operate directly to and from heliports in the centre of each city, but connections to Kastrup Airport at Copenhagen are provided for fixed-wing passengers. The Ostermans service is being operated in co-operation with S.A.S., and no charge is made for transit passengers using the helicopter to connect with the latter's European or international routes; local passengers are charged a single fare of about 28s.

NEW SERVICES APPROVED

THE M.T.C.A. announce Ministerial approval, after consideration of the Air Transport Advisory Council's recommendation, of the following scheduled air services:—

Air Kruise (Kent), Ltd.—An inclusive tour between Lydd and Geneva *via* optional technical stops at Paris (Le Bourget) and Basle until October 31st, 1955.

Airlines (Jersey), Ltd.—Normal scheduled service between Bournemouth (Hurn) and Dinard until March 31st, 1963.

Eagle Aviation, Ltd.—Inclusive tour between London (Blackbushe) and Klagenfurt *via* a technical stop at Luxemburg (Findal) until September 30th, 1955.

Dragon Airways, Ltd.—Internal service between Stoke-on-Trent (Meir) - Birmingham (technical stop only) - Guernsey and/or Jersey until April 7th, 1962.

Hunting-Clan Air Transport, Ltd.—Internal service between Newcastle and Belfast *via* an optional stop at Glasgow (until 31st March, 1960): inclusive tours between Glasgow (Renfrew) and Munich (until September 11th, 1955); London Airport and Zurich (until mid-September 1955).

Starways, Ltd.—Inclusive tour between Liverpool (Speke) and the Isle of Wight (Bembridge) until October 31st, 1956 (May to October).

HUNTING-CLAN'S "AFRICARGO" NETWORK

INAUGURATION of all-freight services between the United Kingdom and Africa by Hunting-Clan Air Transport is scheduled to take place on July 23rd with the departure from Manchester and London of an East Africa-bound York freighter. The decision to operate these services—the first scheduled all-cargo flights ever made between Britain and Africa—follows several years of research by Hunting-Clan.

It is the company's intention ultimately to serve most parts of Africa. It holds the necessary traffic rights to operate between the United Kingdom and East Africa, the Central African Federation and the British territories in West Africa, though negotiations with the South African Government for rights in the Union have not yet been concluded.

From the commercial viewpoint, Hunting-Clan's African project is an extremely interesting one, as it promises to break new ground in several respects. Initially, the East African service will operate weekly, though the airline is free to vary frequencies, operate weekly, though the airline is free to vary frequencies, services will be confined to cabotage routes, which are free from I.A.T.A. jurisdiction, it will also be possible to experiment with tariffs. Hunting-Clan say that the object of their "Africargo" project is to develop new business and not to divert existing traffic from other airlines' scheduled passenger-plus-freight services.

Services will be operated in co-operation with B.O.A.C.; the setting-up of a joint working group, with discussion of tariff experiments as one of its main purposes, represents a further improvement in relations between State and independent operators. Hunting-Clan will also have an inter-line agreement with Airwork for transfer of loads between the former's African and the latter's Atlantic services.

With the object of developing local freight traffic in Central Africa, HCA have established a subsidiary Hunting-Clan African Airways. This company will shortly provide a connection between East Africa and the Central African territories—Nyasaland and Northern and Southern Rhodesia.

TRANSAIR NEWSPAPER FLIGHTS

WE learn from Transair, Ltd., that the article "Newspaper Run" (*Flight*, June 17th) did not give a completely up-to-date picture of the company's early-morning delivery service to Germany. No problem is involved in finding return loads for the aircraft on this route, since the company operates a regular Frankfurt-Paris-London service under contract to the U.S. Army. The outward flight to Dusseldorf and Hanover is made under contract to the Newspaper Proprietors' Association, and it is

Not a "replacement" but a promising new feeder-and-outback airliner in its own right is the Scottish Aviation Twin Pioneer (two 570-h.p. Alvis Leonides), which made its first flight at Prestwick on June 24th. In charge of flight trials is J. H. Capper (right).

"Clipper Jupiter Rex" is the flagship of PanAm's new fleet of seven DC-7Bs, which carry 810 gal additional fuel in the enlarged nacelles of their four Wright Turbo-Compounds—3,250-h.p. piston engines.

scheduled to ensure "breakfast-time" deliveries throughout the area served. These flights, incidentally, form part of a Transair "newspaper network" serving nine points in Europe and involving over 1,400,000 miles' flying per year.

NEWS FROM AUSTRALIA

FIRST steps have been taken in Australia towards the operation of civil helicopter services. The privately owned Australian National Airways announced on June 29th a decision to set up a helicopter division, equipped, initially, with a Bristol 171 Sycamore. In charge of the division will be Capt. Max Holyman, who will be the first A.N.A. pilot to visit Britain for helicopter conversion training. The Sycamore will be used for emergency and feeder services.

Basic rules for the operation of commercial helicopters were laid down on June 19th by Australia's Department of Civil Aviation. It was stated by the Minister of Civil Aviation, Mr. Athol Townley, that special attention would be given to the careful selection of routes, control of noise, and ownership and licensing of heliports. Licences would be considered "in the light of the need to confine the level of engine noise to approximately that made by the rotor blades." The government would provide heliports only at aerodromes; approved standards would be laid down for construction of heliports elsewhere. In general, said Mr. Townley, approval would not be given for use of roof-tops by helicopters which were incapable of operation with one engine stopped. This restriction might be relaxed if the surroundings allowed.

Another important Australian development is the announcement of a Qantas order for two L.1049Hs, for use as combined passenger-freight aircraft on the Sydney - London route. Delivery of this new version (the 22nd) of the Super Connie will be made in mid-1956.

Capable of quick conversion for all-freight services, the L.1049H will feature a strengthened floor of extruded magnesium and large loading doors fore and aft; dimensions of the doors are (forward) 5ft 1½in wide by 6ft 4½in high, and (rear) 9ft 4½in wide by 6ft 2½in high. Its normal maximum payload will be 34,623 lb though Lockheed say that the fuselage will accommodate a further 5,000 lb when authorised to take-off at 5 per cent above its usual gross weight of 137,500 lb. Tip tanks will be fitted, giving an absolute still-air range of 5,580 miles.

Following the introduction of Viscounts by T.A.A. and DC-6Bs by A.N.A., new speed records are being set almost daily on Australian domestic routes. One of the most impressive performances was that of A.N.A. DC-6B *Kurana*, which flew from Perth to Adelaide on June 2nd at an average speed of 420 m.p.h., carrying 47 passengers and 8,000 lb of freight (strong tail winds are encountered on this sector). Another was that of the T.A.A. Viscount, VH-TBC, which—also with tail-wind assistance—recently flew from Melbourne to Sydney at 395 m.p.h. On June 17th, incidentally, T.A.A. carried their 100,000th Viscount passenger; the airline's Viscount services began just six months previously—on December 18th.

Three of the Commonwealth's best-known civil pilots, representing each of Australia's three largest airlines, became M.B.E.s in the present Birthday Honours list: Capt. Keith Virtue of A.N.A., who holds the Australian record of 23,500 flying hours; Capt. Aubrey Koch of T.A.A. (over 17,000 hours) and Capt. Ken Jackson of Qantas (over 15,000 hours).

BREVITIES

THE first Viscount demonstration flight from Washington was operated by Capital Airlines on June 24th. Passengers included the United States General Attorney, Mr. Herbert Brownell; the Under-Secretary of Commerce, Mr. Louis Rothchild; the chairman of the C.A.A., Mr. Ross Rizley; and the administrator of the C.A.A., Mr. F. B. Lee.

* * *

Airports, Ltd., owners of Gatwick, announce that the sum of £350,000 has been agreed as Government compensation for the acquisition of the airport, which is to be developed at a cost of £16m as an alternative to L.A.P.

* * *

The recently opened Aero-Ypenburg helicopter school, now using a single Hiller 12B, has ordered an S.N.C.A.S.O. Djinn for delivery in March 1956. Training charges at the school are reported to be about £30 per hour, and £1,000 for a complete course of helicopter instruction.

* * *

Lufthansa's admission to active membership of the International Air Transport Association was announced on June 29th, bringing the number of I.A.T.A. member companies to 73. One of Lufthansa's predecessor companies was a founder of the pre-war I.A.T.A. in 1919. The Association has also announced the election of Mr. A. A. Priester, a vice-president of PanAm, as chairman of the I.A.T.A. technical committee.

* * *

Hitherto concerned solely with freight, the Colombian airline Sociedad Aeronautica Medellin (S.A.M.) has acquired two DC-3s and two DC-4s with a view to entering the passenger field. The aircraft were supplied by K.L.M., who are jointly concerned with the Colombian airline in the formation of a new company—Rutas Aereas S.A.M., which is expected to take over the passenger services.

* * *

Air France will shortly introduce tip-tanked L.1049G Super Constellations on their transatlantic routes. The airline, which has ten of these aircraft on order, expects the first two machines to arrive in Paris this month; deliveries should thereafter continue at the rate of one a month. The French 1049Gs will be capable of conversion in three hours from 32-seat "Golden Parisian" layout to 81-seat tourist. An innovation incorporated in some of the machines will be the use of nickel-plated airscrews, to give longer service life.

* * *

At present under Air Ministry requisition, Lulsgate Airport has been offered by the M.T.C.A. to Bristol Corporation for use as a municipal airport. Situated about six miles from the city centre, the airfield is open to purchase or lease by the Corporation.

* * *

Civil Aviation Information Circular No. 65/1955 outlines the new conditions under which flying experience gained by first officers acting as "pilots-in-charge under supervision" may be credited towards the command hours required for senior licences.

* * *

DC-4s have replaced Sandringham flying-boats on the Qantas service from Sydney to Noumea, the new Hebrides and Suva. The only flying-boats now used by Qantas are the Catalinas operated on short-haul routes in New Guinea.

* * *

I.C.A.O.'s budget for 1956 will be $2,826,971 (just over £1m); this sum, slightly more than the 1955 budget, was voted at the Organization's ninth assembly, which concluded in Montreal on June 13th. West Germany's request to join I.C.A.O. was approved by the assembly and now awaits final approval by U.N.

* * *

New appointments announced by Sabena include that of M. A. Vernieuwe as executive vice-president; in addition to his present duties as operations manager M. Vernieuwe takes charge of the airline's commercial services and the organization of its overseas stations. Other appointments are those of M. V. Pacco as vice-president, sales, and of M. M. Stainier, as vice-president, operations. The appointments follow the news that Sabena's commercial manager, M. P. Stouffs, has, for family reasons, been granted prolonged leave of absence.

Her Majesty inspecting No. 603 Squadron, R.Aux.A.F., and (above) receiving from W/C. Duncan Smith the Standard for presentation.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

THE QUEEN PRESENTS No. 603 SQN. STANDARD

AT the Palace of Holyrood House, Edinburgh, on June 30th, the Queen presented a Squadron Standard to No. 603 (City of Edinburgh) Squadron, Royal Auxiliary Air Force, of which unit Her Majesty has been Honorary Air Commodore since 1951. The parade also provided the occasion for the presentation to the Queen of a diamond and ruby brooch of the squadron's original badge.

Led by their pipes and drums, and carrying the cased Standard, the squadron marched on to the lawn and formed up facing the Palace. Shortly afterwards, escorted by Air Marshal Sir Dermot A. Boyle, the Queen walked from the Palace door and was received with a royal salute. Her Majesty, attended by the commanding officer, S/L. R. A. Schofield, then inspected the squadron.

Following the inspection was the consecration and blessing of the Standard, which had been uncased and laid on piled drums. At the end of the religious ceremony W/C. W. G. G. Duncan Smith handed the Standard to Her Majesty, who then made the presentation; the bearer was F/L. J. D. A. Henshaw.

In an address following the presentation the Queen said: "It is, I think, very fitting that I should present a Standard to the City of Edinburgh Squadron of the Royal Auxiliary Air Force, of which I am Honorary Air Commodore, here at Holyrood House, which is my home in Edinburgh, and which has been so intimately connected with the life of the Scottish capital throughout its history.

"The award of the Standard marks an important milestone in the life and traditions of the squadron which receives it. The road which you have travelled to reach this point has indeed been one of valour and distinction, for you played a notable part in the defence of our country in the Battle of Britain, in the heroic defence of Malta, and in seven other campaigns of the second world war. The price you paid was heavy, for many good companions fell by the way. Their loss is mourned, but their sacrifice is remembered with pride and gratitude.

"In committing the Standard to your charge, I am confident that you will be worthy of the trust in peace, and if need be in war, and that in the future you will add further lustre to the good name of your squadron and the City of Edinburgh."

In his reply, S/L. Schofield said: "Your Majesty, all members of the squadron are deeply conscious of the great honour bestowed upon it by your award of the Standard. We are very proud that Your Majesty has been able to make the presentation in person. The consecration of our Standard today is a symbol of the achievement and sacrifice of former members of the squadron, and I am sure that every officer, N.C.O. and airman serving in the squadron today, and those who will serve in the future, will uphold the squadron tradition and will receive inspiration from the Standard. I feel sure that the former members of the squadron must feel proud that their squadron has been so honoured."

Stepping up on the dais, the squadron commander continued: "Your Majesty, on behalf of the present and former members of the City of Edinburgh Squadron, I humbly ask you to accept this brooch, fashioned in the shape of the original squadron badge, as a token of our love and gratitude to you, our Sovereign Lady and Honorary Air Commodore."

At the close of the parade S/L. Schofield led in giving three cheers for Her Majesty.

The R.A.F. at Henley

DESPITE great efforts the R.A.F. failed to win any of the finals at Henley this year. In the quarter-final of the Thames Cup they dead-heated with Pennsylvania University and in the re-row won by the narrow margin of four feet. Their time for the first run was 7 min 36 sec, which they reduced to 7 min 25 sec in the second attempt. In the semi-finals for the same Cup, Molesey Boat Club led for most of the course and it was only by a terrific spurt that the R.A.F. were able to win by three feet. The final of the Thames was rowed against the Massachusetts Institute of Technology who won by ¼ length.

In the Diamond Sculls, the only other final in which the R.A.F. participated, S. C. Rand was beaten by T. Kocerka of

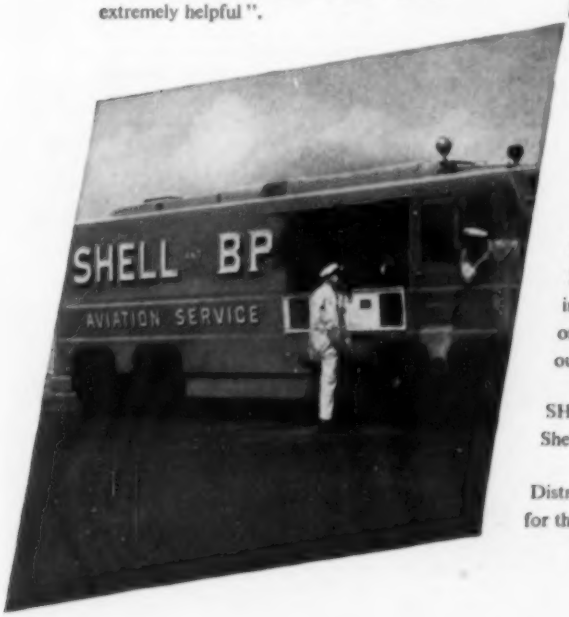
Air Marshal Sir Lawrence Pendred and Lady Pendred, left, receiving guests at the garden party given at Flying Training Command headquarters, Shinfield Park, Reading, last Saturday. This most enjoyable function was graced with splendid weather.

The aeroplane

The Boulton Paul P.111. A highly unconventional delta-wing machine designed for research into the effects of the mysterious 'sound barrier'. Rolls-Royce Nene turbo-jet engine. Span: 33' 6", length: 26' 1". Boulton Paul used fuel supplied by Shell-Mex and B.P. Ltd. and AeroShell lubricants for the P.111's experimental flights.

the pilot

At only 32 years old, Glasgow-born Alexander Ewen Gunn of Boulton Paul is by far the youngest chief British test pilot. Over 900 of his 1,500 flying hours have been clocked on tests — a good many of them in the P.111, which he considers his special 'pigeon'. Joined R.A.F. from school in 1942, Wings 1943, active service in fighters for next two years. Is very modest about his successes over Belgium and Holland during this period. With Boulton Paul since 1949. Says he finds Shell and BP Aviation Service is "always extremely helpful".



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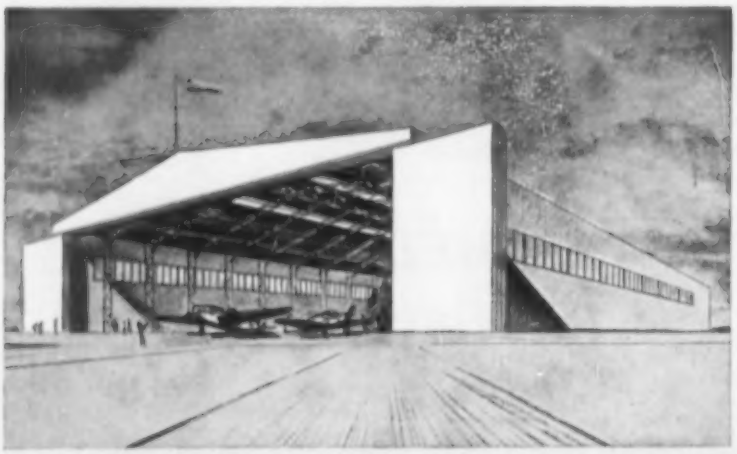

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Half-Yearly Promotions

IN the half-yearly list of promotions, taking effect from July 1st, the following acting Air Vice-Marshals are confirmed in their rank:

G. P. Chamberlain, C.B., O.B.E., A.O.A., Fighter Command; W. H. Kyle, C.B., C.B.E., D.S.O., D.F.C., A.D.C., A.O.C., Malaya; W. C. Sheen, C.B., D.S.O., O.B.E., Director-General of Manning; R. B. Lees, C.B., C.B.E., D.F.C., A.O.C., No. 83 Group; D. G. Morris, C.B., C.B.E., D.S.O., D.F.C., S.A.S.O., 2nd Tactical Air Force; H. D. Spreckley, C.B., O.B.E., Director-General of Technical Services; W. A. Opie, C.B., C.B.E., A.F.R.Ae.S., Assistant Controller of Signals (Air), M.o.S.; F. E. Lipscomb, C.B.E., M.R.C.S., L.R.C.P., D.P.H., D.T.M. and H., Q.H.P., July 1st, 1955, Principal Medical Officer, Home Command; M. J. Pigott, B.D.S., F.D.S.R.C.S., Q.H.D.S., Director, Dental Services.

Group Captains promoted to the rank of Air Commodore are: C. E. S. Lockett; R. Faville, C.B.E.; H. W. Mermagen, C.B.E., A.F.C.; A. D. Messenger, C.B.E.; G. F. W. Heycock, D.F.C.; E. M. Donaldson, C.B.E., D.S.O., A.F.C.; H. B. Wrigley; M. E. M. Perkins, B.A., A.F.R.Ae.S.

The following Wing Commanders are promoted to Group Captain: H. J. Hobbs; G. P. Harger, O.B.E., D.F.C.; R. I. Jones, A.F.C.; D. P. D. G. Kelly, D.F.C.; A. J. M. Smyth, O.B.E., D.F.C.; R. H. Waterhouse, C.B.E., D.F.C., A.F.C.; J. H. Greswell, D.S.O., O.B.E., D.F.C.; R. J. Oxley, D.S.O., O.B.E., D.F.C.; G. C. O. Key, O.B.E., D.F.C.; J. A. Leathart, D.S.O.; H. P. Pleasance, O.B.E., D.F.C.; F. O. S. Dobell; I. G. Esplin, O.B.E., D.F.C.; H. P. Connolly, D.F.C., A.F.C., A.F.M.; J. M. N. Pike, D.S.O., D.F.C.; R. T. Frogley, O.B.E., D.F.C.; E. C. Passmore, C.B.E., A.M.I.E.E.; H. Z. Foreman, O.B.E.; N. W. Wakelin, A.M.I.Mech.E., A.F.R.Ae.S.; A. A. Fletcher, B.Sc., D.I.C., A.R.C.S., A.F.R.Ae.S.; C. T. Jackaman, O.B.E.; E. A. Jackson, O.B.E. (Sen. July 1st, 1954); T. S. Kennedy, O.B.E.; R. F. L. Hart, A.S.A.A.; G. R. Bowler; J. A. Crockett; J. N. Ogle, A.F.C., A.F.M.; L. S. Everett, M.R.C.S., L.R.C.P.; E. A. Rice, O.B.E., M.B., B.Ch.; J. J. Lawson, L.D.S.; H. M. G. Williams, L.D.S.; L. F. Stanley, M.Sc., A.R.C.S., D.I.C.; S. A. Campbell, A.M.I.Mech.E., M.Eng.; J. C. Kilkenny. O.B.E., D.Phys.Ed.

(*To be continued*)

Culdrose Air Day

A CROWD numbering approximately 8,000 turned up at R.N. Air Station Culdrose (H.M.S. *Seahawk*) to enjoy an excellent flying programme and an interesting static display. The various items ran strictly to schedule.

While it may seem invidious to pick out highlights in such splendid flying, some of the performers deserve special mention. These include most certainly S/L. Calvey for his eight-point roll in a Hawker Hunter and Lt. Ogden, R.N., a C.F.S. instructor, who included a half-bunt with inverted climb away when demonstrating a Percival Provost. No. 800 Squadron, R.N., (Lt-Cdr. Lygo) from Brawdy put on a fine show of formation flying and individual aerobatics in their Sea Hawks—concluding the event by landing as a "box." As a spectacular finale, 12 Firefly 7s of No. 796 Squadron, R.N. (Lt-Cdr. Dennis) attacked a strong-point on the airfield and were promptly intercepted by the Meteor 8s of No. 63 Squadron, R.A.F., which unit is, at the moment, on detachment to Culdrose.

Distinguished visitors included Flag Officer Air (Home), Vice-Admiral Caspar John; Flag Officer Flying Training, Rear-Admiral G. Willoughby; and the A.O.C. No. 19 Group, A.V-M. Tuttle. H.M.S. *Seahawk* is commanded by Capt. D. Vincent-Jones, R.N.

Canal Zone "At Home"

AN "At Home," probably the last of its kind to be held in Britain's shrinking Canal Zone base, was given on June 24th by R.A.F. Abu Sueir to British Army Units stationed in the Suez Canal Zone. Guests included Lt. Gen. R. A. Hull, G.O.C. Egypt; A.V-M. D. H. F. Barnett, A.O.C. No. 205 Group; and senior officers of the Egyptian armed forces.

Both the R.A.F. and their guests took part in the afternoon's programme, which opened with the pipes and drums of the 1st Battalion, Seaforth Highlanders, marching and counter-marching. A drill display by the 2nd Battalion, the Grenadier Guards, followed, in which, for the first time, the new F.N. rifle was used. Meteors of No. 208 Squadron then gave a display of formation flying, followed by solo aerobatics by F/O. A. Musker. Next a battery of No. 23 Field Regiment, Royal Artillery, demonstrated control of four guns in action against a hidden target, and a R.A.F. parachute medical team dropped from a Valetta transport aircraft to demonstrate how airborne help can be given to injured in inaccessible places. Temporarily based in Cyprus, two 2nd T.A.F. Sabres dived from 40,000ft to give Egypt its first supersonic bangs.

After an interval, the guests saw an anti-aircraft gun drill display by the R.A.F. Regiment, and a live-cannon attack by 208 Squadron Meteors against a ground target on the airfield. F/O. Lyne gave a gliding display and an Auster A.O.P. demonstrated low-level manœuvres. Concluding the flying side of the programme was further formation flying by Nos. 208 and 13 Squadrons, and supply-pannier dropping from R.A.F. Valettas. The final item was a march past by all participating ground forces at which G/C. Hannafin, Station Commander at Abu Sueir, took the salute. G/C. Hannafin leaves shortly for Britain on conclusion of his overseas tour of duty. In organizing this "At Home" he was assisted by S/L. T. F. Neil.

R.Aux.A.F. Appointment

THE appointment is announced of S/L. H. A. Olivier, R.A.F., to command No. 3507 (County of Somerset) F.C.U., R.Aux.A.F.

S/L. Olivier first joined the R.A.F. in 1936 and has performed a variety of tasks including test flying at an M.U., as an instructor at an F.T.S., operations with the R.A.F. Element, Eastern Air Command and as Senior Operations Controller.

Varied events in the At Home by R.N. Air Station Culdrose on June 25th: (Top left) Skyraiders of No. 849 Squadron peel-off for a stream landing. (Top right) A Meteor 8 of No. 63 Squadron gets in among Fireflies attacking the airfield. (Bottom left) A Fairey Gannet provides a wealth of interest in the static aircraft park. (Bottom right) Hawker Sea Hawks of No. 800 Squadron land in formation.

ATOMIC EXERCISE

Carte Blanche: The Practical Assessment of Future Warfare

SPEAKING at Fontainebleau at the beginning of exercise Carte Blanche, Air Chief Marshal Sir Basil Embry, Commander-in-Chief, Allied Air Forces Central Europe, defined the purpose of the exercise as the practical assessment of theories on atomic attack and defence. The exercising of all units which this entailed was, he said, part of the normal process of maintaining efficiency. A major requirement for any future conflict would be a peace-time state of instant readiness, since there would never again be any time for a build-up of strength during initial battles. The particular significance of this for the air forces was that, for the present, the first, and possibly decisive, phase of a war would take place in the air; and that the duty of the defending forces would be first to smash the enemy's atomic capability, and secondly to provide such defence as was possible against the enemy's atomic attack. Implicit in this was the need for extensive and efficient communications between widely dispersed mobile units, and rapid and effective reconnaissance, directed at finding the enemy's critical installations.

Therefore, though Carte Blanche was almost entirely an air exercise, it provided an accurate picture of the decisive phases of an atomic conflict.

As reported last week, the two sides involved were Northland (2nd A.T.A.F.) and Southland (4th A.T.A.F.). Both were highly industrialized countries which had reached a point in their relationship where one side decided to make war on the other. For three days before the opening of hostilities, both sides prepared actively for war by deploying their air forces for attack and defence. At 0001 hr on Thursday, June 23rd, the war began, theoretically without any declaration. Most of the atomic sorties were flown by aircraft of Strategic Air Command and 49th Air Division, U.S.A.F., and the task of the two A.T.A.F.s in these operations was to provide interceptions and fighter escort. Most of the targets were decided, as related last week, by SACEUR but commanders in the field, Air Marshal Sir Harry Broadhurst, 2nd A.T.A.F., and General Lee, 4th A.T.A.F., could request an atomic strike on any targets they considered suitable. Information as to how many requests were made and how many of them were granted was not released. All Northland aircraft carried a gold band round the after-fuselage and all Southland aircraft carried crosses on tail and wings in any colour except gold or orange. Stocks of fuel and ammunition for several days were held at each airfield and war-time supply systems were in use. Bomb disposal teams had to deal with 16 unexploded bombs, six of them live, but none atomic.

By Thursday night, ten Southland airfields had been atom-bombed and Southland had reacted with similar attacks on seven Northland bases. Northland's initial blow, however, was severe enough to reduce Southland's atomic capability to a very low ebb during the first two days. The advantages of deployment soon became evident since not all the many airfields available were occupied. Celle, for instance, was unoccupied when destroyed and the Belgian wing at Brüggen was airborne at the time of attack and was diverted elsewhere.

On June 24th, 24 hr after the exercise had started, *Flight* visited No. 34 TAC.R Wing at Gütersloh. This was a composite wing made up of an R.A.F. squadron of Meteor F.R.9s, a Dutch squadron of RF-84Gs and some flights of Danish and Norwegian RF-84Gs. Also operating there was a wing of Canberras, and the station had just started again after the "effects" of an atom bomb attack made on the previous day. Gütersloh had had rough treatment including an intrusion by a B-26 and an unexploded bomb during Thursday night; then, on Friday morning, somebody blew up the runway. But the FR wing was still operating and some pilots reported that they had found a heavily camouflaged Matador on its launching ramp. It is the fighter reconnaissance units who obtain a large part of the information required for selecting targets and for observing the effect of previous attacks. No. 34 Wing was therefore busy and its Mobile Field Processing Unit (with both Dutch and English personnel) developing and printing photographs had, by the time of our visit, produced 10,000 prints. The air-conditioned processing caravans were expertly tucked away in a shallow pine-wood some way from the airfield.

Next visited was No. 2 Group's Sector Operations Centre, buried deep in a forest of huge beech trees "somewhere near Sundern." On the sandy floor of the forest, surrounded by barbed wire entanglements and covered with camouflage netting, the caravans had been opened out to form a war-room and offices and become the nerve centre of the group's operations, run 24 hours a day on a watch system and directed by the A.O.C. and S.A.S.O. (If one such centre were destroyed only one of several watches' personnel would be lost and only half the Command, and operations would continue to be directed from other headquarters and with other equipment. A Command centre would have to be destroyed many times before it became impossible any longer to control the formations in the air.)

Incidentally, each unit checked its own camouflage by visual and photographic reconnaissance every day, and first results were so good for 2 Group S.O.C. that the Auster pilots could not find their headquarters at all, though they knew its map reference. Communications, a sore point in previous exercises, were now going very much more smoothly, and were assisted considerably by the introduction of beam radio links which require no land lines.

We learned that Gütersloh had been hit the previous day by a Matador with an atomic warhead. These pilotless bombers were being simulated in the exercise by T-33s and their speed was reported to be 300 m.p.h.

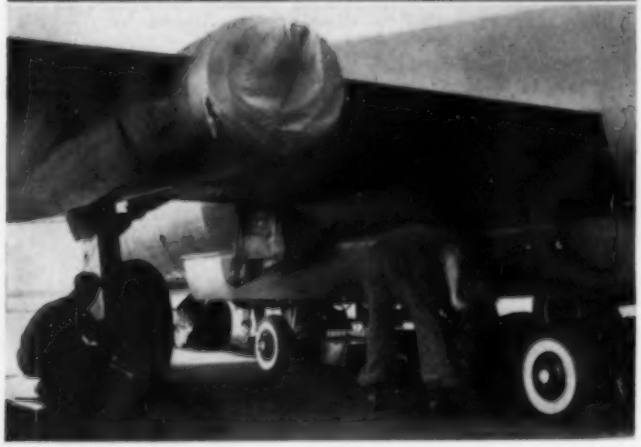
We next went to see the Air Control Centre which was if possible even more cunningly hidden than the S.O.C. By dropping camouflage netting round the border of a clump of trees, a complete hall had been formed to house the filter plotting centre, met. office and communications. In a neighbouring barn a whole fighter control unit, complete with control cabins, Army liaison cabin, general situation board and tote board, had been set up; and work on a shift system had been going on unceasingly since before the exercise began.

By the evening of the second day 15 airfields of 4th A.T.A.F. had been successfully atom-bombed and eight 2nd A.T.A.F. airfields had suffered retaliatory attacks. Though Northland, the agressor, by now seemed to have the upper hand, Southland could soon expect to have the nuclear support of the U.S. Sixth Fleet in the Mediterranean. Northland was laying special plans to counter this trap. Questions began to be asked about the total level of radio activity in Europe and it already appeared that the saturation point must have been reached some time before. Several airfields were atom-bombed for the second time, though this would, of course, not be necessary in an actual conflict. But for security reasons no satisfactory answers were supplied. Meantime the aircraft losses on both sides were comparatively small, with Northland claiming 29 aircraft, two Matadors and, for some reason, one Zeppelin. Twenty-five sorties were flown with conventional weapons against Matador launching sites. Reconnaissance was still one of the major tasks with interception a close but much less hopeful second.

Hunters at Jever

By the third day, the war had settled down and atomic attacks succeeded one another with a regularity which, to the uninitiated, appeared monotonous, though appalling in its implications. The pace had slowed down considerably and all the complicated machinery was operating quite smoothly. The opportunity was therefore taken of visiting Jever where the first squadrons in 2nd A.T.A.F. to receive Hawker Hunters were now converting.

Hunters from Jever seen from the starboard seat of a Vampire T.11.



(Top) A Meteor F.R.9 at Bierset in Belgium with F/O. G. Marlow, who flew "Flight's" representative on a reconnaissance to Bitburg. (Centre) Helicopters were extensively used in Carte Blanche. These white Sycamores and a silver Dragonfly were at Wildenrath. (Bottom) A Canberra B.2 being bombed up at Gütersloh. The wheels are jacked up to allow the handling trolley with its clutch of bombs to be wheeled in under the tail. Hydraulic jacks then lift the bombs up to the carriers.

Since the Sabre squadrons based at Jever were completing their annual gunnery attachment at Sylt and only a small number of Hunter pilots had as yet done enough flying to take part in the exercise, Jever was not at war. When we visited them they were just recovering from one of Northern Germany's characteristic cloudburst-like thunderstorms, but four Hunters were ready to scramble. Two squadrons, No. 98 (S/L. J. H. Smith-Carrington) and No. 118 (S/L. C. M. Gibbs) had moved to Jever for conversion, leaving their Venoms behind them elsewhere in Germany. The Hunters are, of course, of the Mk 4 variety, incorporating a number of improvements about which the pilots are enthusiastic but which, unfortunately, cannot be detailed. So pleasant has the Hunter proved to fly that it was said that the main difficulty was considered to be a tendency towards over-confidence. The four pilots had already, in the space of six weeks, become operational and were standing by to join in Carte Blanche. But as the weather improved rapidly and the cloudbase went up to 800ft, the four aircraft took off and allowed themselves to be photographed from a Vampire Trainer.

Time was short, however, and we had to fly back to Muenchen Gladbach. By the evening of Saturday, 36 atom bombs had been dropped and the advantage still lay with 2nd A.T.A.F., although the intervention of the U.S. Sixth Fleet was expected hourly. The tactical aims of both sides had now clearly emerged as the destruction of each other's atomic capability. The requirement was for search by reconnaissance, pin-pointing by assessment and communications, and destruction by attack. And once an attack had been made reconnaissance was again required to assess the result.

At Bierset, near Liège, we visited No. 2 Squadron which had been re-deployed there at the beginning of the exercise, together with the Belgian No. 42 Squadron, with which they were normally based in Germany. The Belgians with RF-84Gs were somewhat under strength since they were using their last aircraft before being equipped with RF-84F Thunderflashes. No. 2 Squadron personnel were living under canvas in a field some distance from the runway and the wing ops centre was heavily camouflaged beneath some trees nearby. The squadron's Meteor F.R.9s, under the command of S/L. R. H. G. Weighill, the former Rugby international, had been heavily engaged since the beginning of the exercise in keeping an eye on various airfields just across the bomb-line. They had seen Matadors and claimed to have photographed two F-100s at Bitburg. We immediately accepted an invitation to fly down there in a Meteor 7 with F/O. G. Marlow.

It is the job of FR aircraft to sneak in over the target at fairly high speed, take one quick look if there is any likelihood of opposition, and return to base at full bore with their reports and photographs. The essence of the approach is to keep below radar cover and to sneak up valleys, making maximum use of natural cover, but, owing to a number of misfortunes during the early days of the exercise, their minimum height had been raised to no less than 2,000ft with the result that they were well inside radar cover and could make no use of their normal techniques. Bitburg was heavily occupied with F-86s and F/O. Marlow expected plenty of resistance. However, when we arrived over Bitburg all was calm; in fact the station had every appearance of being closed for the weekend. But there, on two dispersal pans, were two F-100s with enormous under-wing tanks and their characteristic aggressive attitude.

As Sunday, the fourth day, drew to a close the pace was deceptively slack, but we felt that the last two days would be decisive in one way or another because then no holds were barred. It was going to be "free play" of atomic weapons; any airfield knocked out would stay knocked out until the battle came to an end because there were no forces left on either side.

At the time the exercise ended on June 28th, 12,347 sorties had been flown and 300 simulated atom bombs had been dropped. Though full assessment would take several months it was already clear that, in the words of A. Cdre. P. G. Wykeham-Barnes, chief of operations, A.A.F.C.E., atomic war would be "short and horrible." "In an all-out atomic war," he said, "there would be no winners and no losers, and little left to assess." The main task of A.A.F.C.E. lay in providing an efficient deterrent to war by remaining at a perpetual state of readiness. In any case it was certain that one or other side would suffer fatal damage within the first two days, and that everything possible must be done to prepare the fighting units for the effect of atomic attack; they must continue operations despite the destruction and disorganization which would follow the dropping of each atomic weapon. Procedures and communications had worked well, but further simplification was still desirable and the flying units would have to be prepared to meet such threats as complete jamming of radar services. In the two years which had elapsed since exercise Coronet, A.A.F.C.E. had been built up into a key unit in the defence of the western world.

PRECISION APPROACH RADAR DEMONSTRATED

AT Hatfield airfield last week Elliott Brothers (London), Ltd., gave a demonstration of the American Laboratory for Electronics' SPAR portable precision-approach radar equipment, for which they now have the sales rights for the United Kingdom. The qualities claimed for SPAR are its lightness, cheapness, portability and great accuracy and, besides many civil sales in the U.S.A., orders have been placed by the U.S.A.F. and the U.S. Navy. The latter has given it the designation GPN-6.

SPAR consists of two units, the azimuth and elevation scanners and the R.F. head on a tripod mounting, and a two-wheeled covered trailer housing the display. The trailer is also used for transporting the scanners. Range is ten miles and the accuracy up to 0.5 per cent of range from touch-down, plus or minus 20ft. The scan rate is 2 c.p.s. over 30 deg in azimuth and 2 c.p.s. over 10 deg in elevation. Circular polarization is provided for reduction of rain returns and is claimed to eliminate precipitation clutter. Both glide-path and centreline displays are on the same tube-face, with a single control for the operator; and the display itself can be positioned up to 10,000ft from the scanner unit. SPAR can be unloaded, set up and calibrated in one-and-a-half hours, and this was, in fact, done at Hatfield. A set is to be installed there permanently. Laboratory for Electronics have also announced a new airfield surveillance S-band radar with a range of 50 miles and moving target indication, called STAR.

THE INDUSTRY

New "Densified Wood" Companies

FOLLOWING negotiations with Jablo Plastic Industries, Ltd., it is announced that Permali, Ltd., have registered two new subsidiary companies. They are Hydulignum-Jabroc (Tools), Ltd., and Jabroc, Ltd. Mr. J. H. Collins, B.Sc., F.R.I.C., will manage both the new companies.

Hydulignum-Jabroc (Tools), Ltd., with registered offices at Hydulignum Works, Haddenham, Bucks, and works at Mill Lane, Waddon, Croydon, Surrey, will manufacture metal forming tools and jigs for the aircraft and engineering industries. This company will combine the tooling businesses in laminated densified wood, metal and other materials formerly conducted by Hordern-Richmond, Ltd., Jablo Plastics Industries and Moulded Components (Jablo), Ltd. Re-equipment and extension of the Croydon works will provide a substantial increase to existing capacity. Directors are A. A. Heath, M.A., M.I.E.E.; J. H. Collins, B.Sc., F.R.I.C.; B. Jablonsky, A.F.R.Ae.S.; Lord Selsdon, D.S.C.; J. Watson, F.C.I.S.

Jabroc, Ltd., with registered office and works at Mill Lane, Waddon, will continue the manufacture of Jabroc densified wood laminates, in accordance with existing manufacturing specifications. Arrangements have been made for the completion of all open contracts placed with Jablo Plastics Industries and Moulded Components (Jablo), Ltd., and for the future sale of Jabroc material. Directors are H. Howarth, J. H. Collins, B. Jablonsky and Lord Selsdon.

Starting and Towing

A PARTICULARLY useful form of ground power unit is the self-propelled type, which can also be used to move aircraft. Three such starting and towing units have been supplied for the Royal Iraqi Air Force, by Aerocontacts (Ground Equipment), Ltd., Gatwick Airport, Horley, Surrey.

The vehicles, which were manufactured by Red Devon, Ltd., of Totnes, are larger (14ft 6in long×6ft 3in wide) than the accompanying illustration would suggest, but they are only 4½ft high, and can therefore be driven under the wings and fuselage of large aircraft. Two models are available. One, with either a diesel or Ford V.8 petrol engine, can deliver a continuous 28.5 V output of 600 amp for general servicing, and a peak capacity of 1,650 amp for starting purposes.

The second, and larger, model is available as a diesel unit only; it is capable of a continuous 800 amp output, with a peak capacity of 2,000 amp.

Three of the starting and towing units, similar to those supplied to the Royal Iraqi Air Force by Aerocontacts (Ground Equipment), Ltd.

Contested by 45 Goodyear factories all over the world, the Hinshaw Safety Trophy has been won by the company's aviation division at Wallasey, Cheshire, which in 1954 completed 642,732 man-hours without recording a lost-time accident. Mr. H. L. Ginaven (right), production director, Wolverhampton and Wallasey, presented the award to Mr. C. J. Thomas (left), Wallasey plant superintendent.

Vibrations to Order

DESIGNED for the investigation of vibration phenomena in the products of the aircraft, electronic and other industries, a range of vibration generators is manufactured by Goodmans Industries, Ltd., Axiom Works, Wembley, Middlesex. Apparatus of this type is, in effect, an electro-dynamic exciter, employing a moving coil operating in a strong magnetic field to provide the physical vibration; this is then controlled by matched electronic driving equipment which accurately determines its amplitude, frequency and force.

For some time past, four models have been available, covering a frequency range of from 3,000 to 10,000 c.p.s., and with peak thrusts of from 2 lb to 300 lb. To these has lately been added a new unit, designated Model 16/600, capable of exerting a maximum thrust of 500 lb (27 lb/amp) over a frequency range of up to 1,000 c.p.s. Like the other models, the 16/600 is supplied with a trunnion mounting which provides a choice of angles for the driving shaft.

To the range of driving equipment, also, a new model has been added. Known as the D.120, and providing an output of 120 W over a wide frequency-range, it has been designed for use with the Goodman Model 390A generator (25 lb peak thrust, frequency to 10,000 c.p.s.).

New Shell Films

A TELLING impression of the size of the oil industry, and of the way in which discovery of oil affects a countryside and its people, is given in *The Oilmen*, a recent addition to the Shell film library. In *Proud Ships*—another new Shell film—the story of an individual vessel and its men is cleverly interwoven with an account of tanker operations in general. *Proud Ships* is obtainable now, and *The Oilmen* will be available shortly, on loan from Petroleum Films Bureau, 29 New Bond Street, London, W.1. Both are sound films, and have been made in 16mm and 35mm sizes.

IN BRIEF

At its annual meeting, to be held on July 15th, the R.F.D. Co., Ltd., and its subsidiaries will report a 1954 profit of £53,751 after deduction of tax, as against £37,150 for the previous year. A final dividend of 10 per cent, less tax, is recommended.

* * *

Details of two one-day conferences on the theme "Fuel Efficiency Pays" have been announced. They are to be organized by the East Anglian Regional Advisory Council for Further Education, in conjunction with the National Industrial Fuel Efficiency Service, and will take place on July 13th at Norwich and July 14th at Cambridge. There will be no conference fee. Further details can be obtained from Dr. F. Lincoln Ralphs, Secretary, East Anglian Regional Advisory Council for Further Education, Stracey Road, Norwich, or Mr. E. J. Tickner, N.I.F.E.S., Block 'C,' Brooklands Avenue, Cambridge.

It is announced that Ottico Meccanica Italiana, of Rome, have appointed Photonic Equipment (London), Ltd., 9 Newman Street, London, W.1, as their United Kingdom agents. Ottico Meccanica —whose president, Dr. Umberto Nistri, was recently invited by the Photogrammetric Society to lecture in London—manufacture a large variety of air-survey cameras and precision plotting instruments for map-making.

* * *

The formation of a new company, Cossor Instruments, Ltd., has been announced by A. C. Cossor, Ltd. The company will design and develop new instruments to meet the demands of research and industry. The chairman is Lord Burghley, and Messrs. J. S. Clark, H. Chisholm, H. T. Shepherd, and L. A. Woodhead (general manager) form the board. The firm will be located at Cossor House, Highbury Grove, London, N.5.

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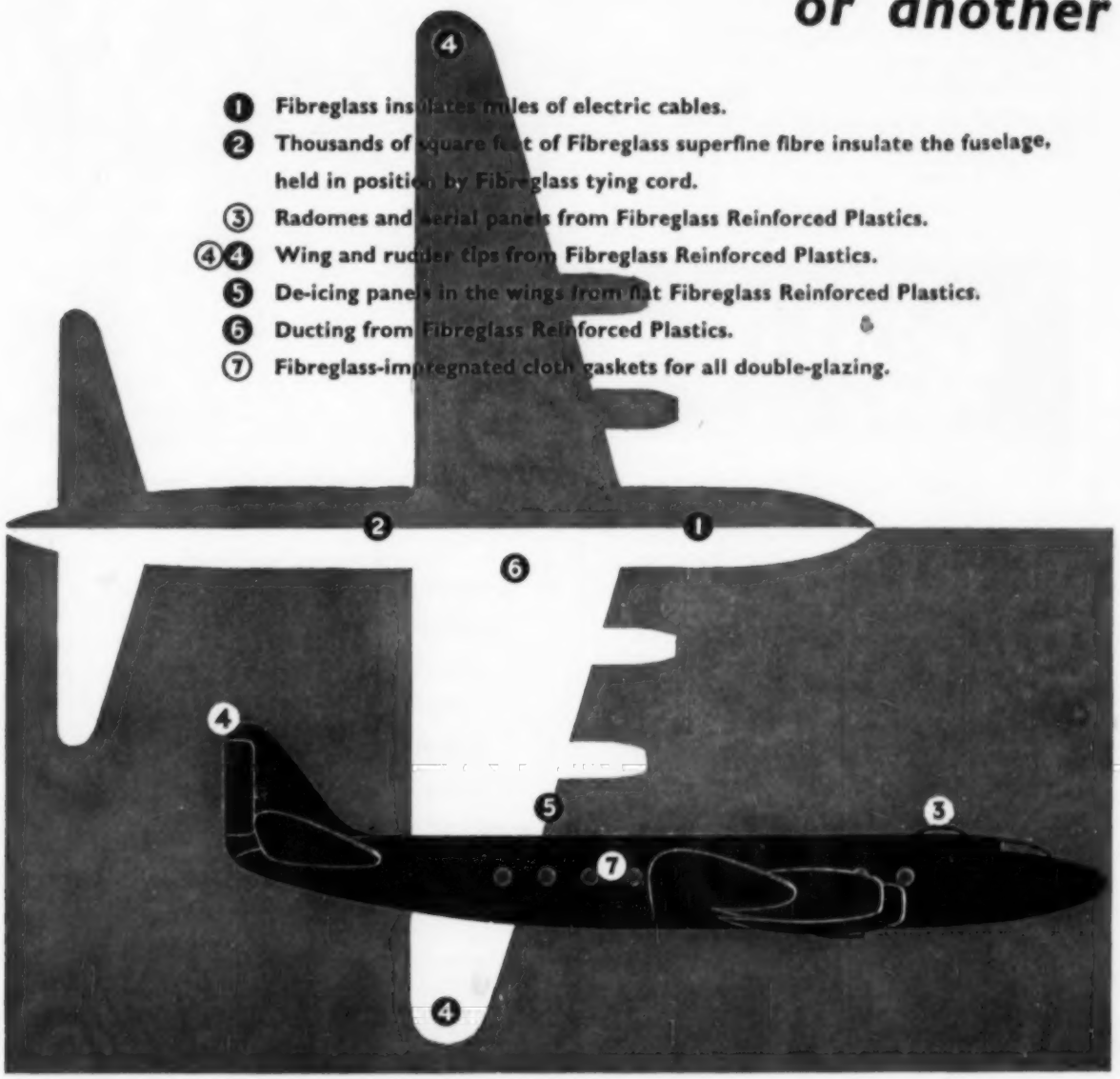

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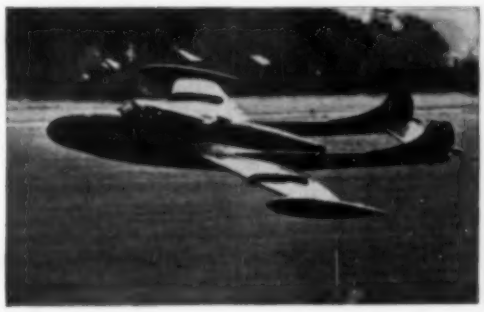

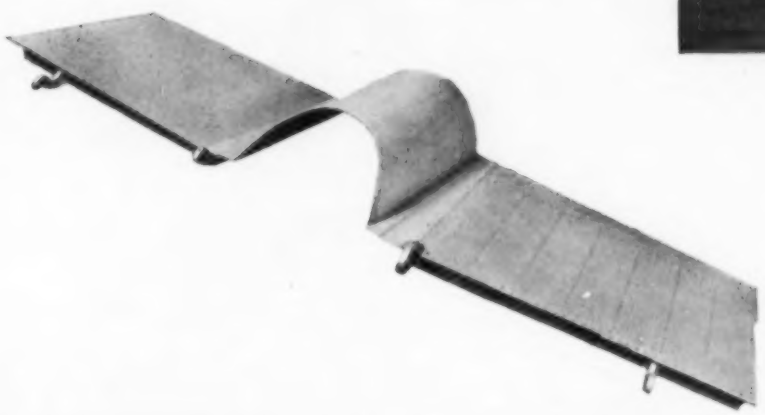

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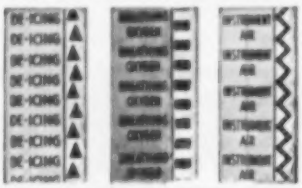

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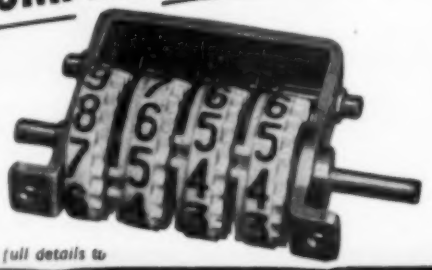

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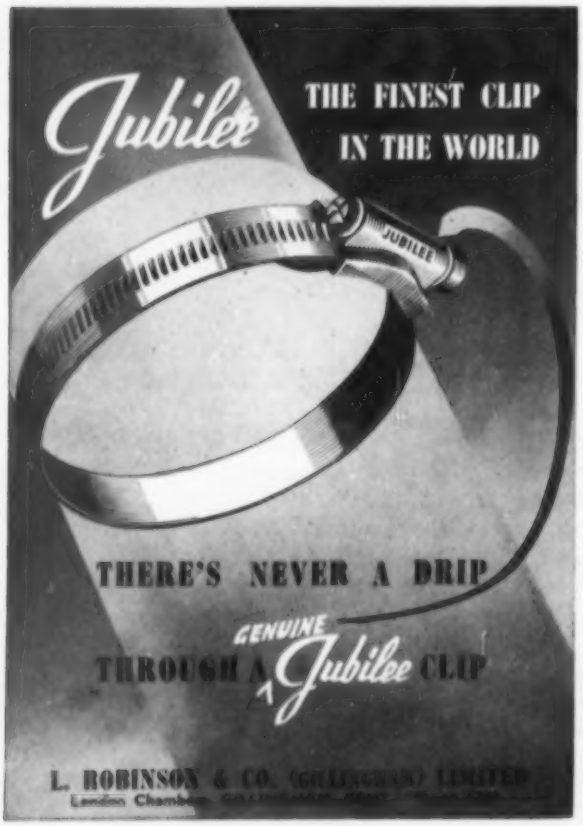

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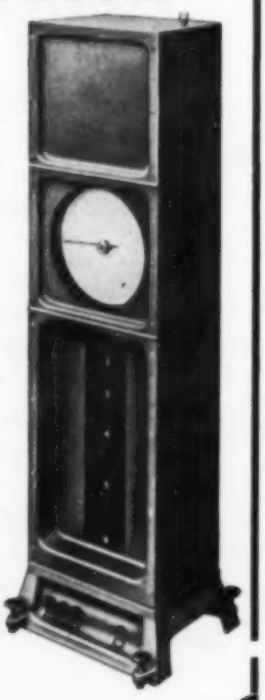

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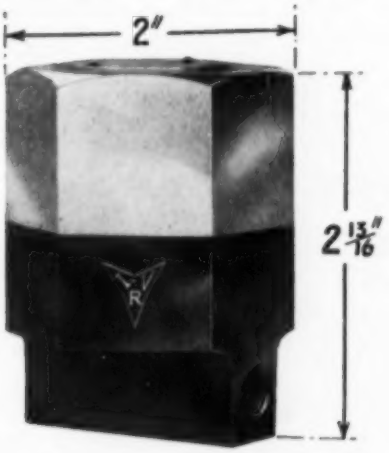

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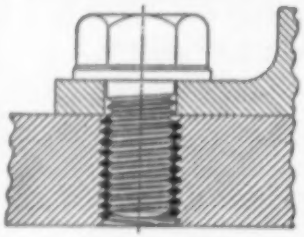

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PUBLIC ANNOUNCEMENTS

AIR TRANSPORT ADVISORY COUNCIL

THE Air Transport Advisory Council give notice that they have received the undermentioned applications to operate scheduled air services:

APPLICATION No. 312/1. From Aquila Airways, Ltd., of 1 Great Cumberland Place, London, W.1, for an increase of frequency or from two as at present authorised up to three services per week during the months of August and September on the Normal Scheduled Service which they are approved to operate between Southampton and Genoa and/or Santa Margherita for the period up to 31st May, 1962.

APPLICATION No. 511. From Eagle Aviation, Ltd., of 29 Clarges Street, London, W.1, for a U.K. Internal Service with Viking and/or Dakota aircraft for the carriage of passengers, supplementary freight and mail between London (Blackbushe) and Jersey at a frequency of up to 24 return flights weekly to be operated on Fridays, Saturdays, Sundays and Mondays during the season from April to October inclusive, each year, for a period of seven years commencing 1st April, 1956.

APPLICATION No. 512. From Hunting-Clan Air Transport, Ltd., of 72 Wigmore Street, London, W.1, for an Inclusive Tour Service with Viking aircraft for the carriage of passengers in conjunction with The Wayfarers Travel Agency, Ltd., between London Airport and Basle, at a frequency of one return flight per fortnight during the period from 24th December, 1955, to 18th March, 1956.

APPLICATION No. 437/1. From British European Airways Corporation of Keyline House, Hounslow, Middlesex, for a Normal Scheduled Service with Viscount and Elizabethan aircraft for the carriage of passengers, supplementary freight and mail between Manchester (Ringway) and Barcelona and/or Palma with an optional intermediate traffic stop at London, at a frequency in accordance with traffic demand initially during the season from June to September inclusive each year, for a period of 10 years commencing 1st April, 1956.

FROM Eagle Aviation, Ltd., of 29 Clarges Street, London, W.1, for the following Inclusive Tour Services to be operated with Viking and/or Dakota aircraft for the carriage of passengers and supplementary freight in conjunction with Wenger Air Tours, Ltd., at a frequency of up to four flights weekly in each case for a period of seven years commencing 1st May, 1956:

APPLICATION No. 513. For a service between London (Blackbushe) and Pisa (San Guiste) during the season May to October inclusive.

APPLICATION No. 514. For a service between London (Blackbushe) and Klegenfurt during the season May to October inclusive.

APPLICATION No. 515. For a service between London (Blackbushe) and Biarritz for San Sebastian during the season May to October inclusive.

APPLICATION No. 516. For a service between London (Blackbushe) and Rijeka during the season May to October inclusive.

APPLICATION No. 517. For a service between London (Blackbushe) and Basle during the season April to October inclusive.

THESE applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on 30th July, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections.

THE Air Transport Advisory Council also give notice that the following application has now been withdrawn:

APPLICATION No. 43/3. From Airwork, Ltd., of 15, Chesterfield Street, London, W.1, for permission to include Blantyre as a traffic stop on their Colonial Coach Service between London and Salisbury (Southern Rhodesia) which was advertised in "The Times," "The Aeroplane," and "Flight" on 24th June, 1955. [3946

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30 Central Chambers, Ealing B'way, London, W.5. Phone: Ealing 8949. [0249

SURREY Flying Club, Croydon Airport, M.C.A. approved for private pilots' licences. Open seven days a week. Croydon 7744. [0293

A.F.R.Ae.S., A.R.B.Certs, A.M.I.Mech.E., etc., on "no pass, no fee," terms; over 95 per cent successes. For details of exams and courses in all branches of aeronautical work, navigation, mechanical eng. write for 144-page handbook free.—B.I.E.T. (Dept. 702), 29 Wright's Lane, London, W.8. [0707

AIRWORK GENERAL TRADING CO. LIMITED

BLACKBUSHE AIRPORT
CAMBERLEY, SURREY

have vacancies for the following hourly rated staff for employment at their Blackbushe Maintenance base:

(1) Engine Fitters, preference given to applicants with Hercules and Pratt and Whitney experience.

(2) Airframe Fitters, preference given to applicants with experience on Hermes, Viking, Dakota and Viscount aircraft.

(3) Aircraft Electricians.

(4) Detail Fitters.

Licensed Engineers

(1) A Licensed Engineers with Viscount airframe endorsement.

(2) C Licensed Engineers with C licence on Dart engine.

Applicants should write giving details of past experience to **Works Manager, Airwork General Trading Company, Limited, Blackbushe,** or call for interview at above address. Telephone Camberley 1600 extension 47.

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MT.C.A. Approved Courses at the LONDON SCHOOL OF AIR NAVIGATION in conjunction with AIRWAYS AERO ASSOCIATIONS, LTD., for the COMMERCIAL Pilot and Instrument Rating.

ALSO Full-time coaching for all other professional Pilot/Navigator qualifications.

HOME-STUDY (correspondence) courses excellent alternative. Link, Briefing, Procedures, R/T, Airways, Type Ratings.

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OFFERS completely co-ordinated and integrated training for professional pilots/navigators.

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TRAINING focalised London.

FULL-TIME personal coaching Com./IR:Sen./Com:ALTP:F/Nav. Pungent and effective.

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BRITAIN'S AIR UNIVERSITY CAN TRAIN YOU for an airline career. Hundreds of today's airline captains and key maintenance personnel are graduates of this famous establishment. Courses are available for Commercial and Airline Transport Pilots' Licences, Instrument Ratings and Maintenance Engineers' Licences.

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VICKERS-ARMSTRONGS (AIRCRAFT) LIMITED

require

AT WEYBRIDGE AND HURN, NR. BOURNEMOUTH, HANTS

(a) **ELECTRICAL INSPECTORS** for aircraft finals and stage work on electrical installations, testing, etc. Previous aircraft experience not essential—ex-Servicemen with suitable experience are welcomed as applicants.

Applications, quoting date and prefix letter of advertisement, to: **Employment Manager, Vickers-Armstrongs (Aircraft) Limited, Weybridge Works, Weybridge, Surrey.**

Weybridge is 30 minutes from London on the main Waterloo/Portsmouth line.

Additional 'buses operate to and from the works at starting and finishing times.

Canteen facilities.

Applicants should be in a position to arrange their own housing accommodation. Assistance can only be given with individual lodgings.

Holidays already arranged by applicants this year taken into account.

GLOSTER AIRCRAFT CO. LTD.

GLOUCESTER

HAVE VACANCIES ON SUPER-PRIORITY DESIGN AND DEVELOPMENT PROJECTS

FOR

AIRCRAFT DESIGN DRAUGHTSMEN

(SENIOR & JUNIOR)

Consideration will also be given to Draughtsmen with Mechanical, Structural or Electrical experience.

Also

STRESSMEN

(SENIOR & INTERMEDIATE)

for both strength and flutter calculations.

The conditions of employment are good with progressive salary, good sports and welfare facilities, pension scheme, etc.

APPLICATIONS STATING AGE, PREVIOUS EXPERIENCE AND EMPLOYERS SHOULD BE ADDRESSED TO THE

CHIEF DESIGNER

TUITION

FREE! Brochure giving details of courses in all branches aero eng. covering A.F.R.Ae.S., M.C.A. exams, etc. Also courses for all other branches of engineering.—Write: E.M.I. Institutes, Dept. F26, London, W.4. (Associated with H.M.V.) [0964

SOUTHEND-ON-SEA Municipal Air Centre and Flying School. Comprehensive flying training for all pilots' licences, ratings and endorsements. Special facilities for instruments, night flying and commercial pilot licences. No entrance fee or subscriptions. M.T.C.A. approved 30-hour course.
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LEARN to fly for £26. Instructors' licenses and instrument flying for £3/5/- per hour. Night flying £4/5/- per hour. Residence 5 gns. weekly. Approved M.C.A. private pilots' licence course. Specialized course for junior commercial pilot's licence. Wiltshire School of Flying, Ltd., Thruxton Aerodrome, nr. Andover, Hants. Tel.: Weyhill 352. [0253

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through the local office of the Ministry of Labour and National Service, etc., if the applicant is a man aged 18-64 or a woman aged 18-59 inclusive, unless he or she or the employer is excepted from the provisions of The Notification of Vacancies Order 1952.

LONDON firm (Willesden) employing approx. 50, aircraft production require:

CHIEF INSPECTOR

FULLY experienced A.I.D. and A.R.B. procedure. Box 4980. [3949

SITUATIONS VACANT

D. NAPIER & SON, LTD.,

FLIGHT DEVELOPMENT ESTABLISHMENT

LUTON AIRPORT

AN expanding section dealing with the problems of icing on aircraft has the following vacancies:—
(1) Electro-Mechanical Engineer.
Degree, H.N.C. or equivalent. Should have several years experience on aircraft electrical systems or electro-mechanical apparatus. Duties involve design of electrical installations as applied to de-icing and other heating problems.
(2) Senior and Junior Technologists to deal with problems of heat transfer, preferably with aerodynamic or aircraft background. Work involves practical and theoretical investigation into ice protection problems. H.N.C. and O.N.C. standard required.
(3) Assistant for investigations in an icing wind tunnel near Guildford. O.N.C. standard.
APPLICATIONS with full particulars of experience and qualifications to Dept. C.P.S., 336/7 Strand, W.C.2, quoting Ref. No. 1309H. [3930

PERSONNEL MANAGER

required by well-known

AIRCRAFT COMPANY

APPLICANTS should have wide experience of Trade Union negotiations, Labour relations, Apprentice Training Schemes and Selection and Engagement of all types of personnel. Some previous experience in the Engineering Industry essential. The position carries executive responsibility and is pensionable.
PLEASE write stating full details of experience, age and salary required to Box F. 675 c/o 191, Gresham House, E.C.2. [3951

ELECTRICAL ENGINEERS

A RAPIDLY expanding aircraft instrument firm engaged on the design and development of autopilots for aircraft and helicopters has vacancies for Electrical Engineers, for testing and developing electro-hydraulic servomechanisms.
PREVIOUS experience with hydraulics desirable but not essential, Good electrical knowledge is necessary. Duties will include testing equipment at hydraulic firms.
PLEASE apply giving full details of career and salary required (which will be treated in strict confidence) to: Personnel Officer, Louis Newark, Ltd., Prefect Works, Purley Way, Croydon, Surrey. [3954

HELICOPTER FITTERS

DUE to increased requirement applications are invited from engine and airframe fitters who would be interested in employment with prominent British whaling company to work on Westland S.55 helicopters operating with Antarctic floating factory expeditions, departing each year October, returning April/May. Attractive terms include good salary and two months' paid holiday each summer. Preference given to fitters with previous helicopter experience. Applications with full particulars to Chr. Salvesen and Company, 29 Bernard Street, Leith. [3959

HELICOPTER PILOTS

APPLICATIONS are invited from pilots who would be interested in employment with prominent British whaling company as first officers of Westland S.55 helicopters operating with Antarctic floating factory expeditions, departing each year October, returning April/May. Attractive terms include good salary, two months' paid holiday each summer, personal insurance, etc. Preference given to pilots already possessing helicopter experience and commercial licence. Applications with full particulars to Chr. Salvesen and Company, 29 Bernard Street, Leith. [3958

PRODUCTION MANAGER

VACANCY occurs in a well-known aircraft engineering firm, for a Production Manager. Applicants must have had considerable experience of modern production methods, planning, estimating, etc. To be responsible direct to the Board, excellent prospects. Application in confidence to the Works Director, Box 4979. [3947

Captains and First Officers required by

B.K.S. AIR TRANSPORT LIMITED,

1, Marylebone High Street, W.1.
Tel.: Hunter 9744.

FOR THEIR FLEET OF DAKOTAS AND VIKINGS [3948

WANTED. Flight Engineers with minimum 1,000 hours experience on Constellation aircraft. Two years contract. Inclusive salary £109 7s. 6d. per month. Box 4787. [3912

SITUATIONS VACANT

WIRELESS Operator Mechanics required by

FALKLAND ISLAND Dependencies Survey for service at isolated British Bases in the Antarctic. Must be able to transmit and receive morse at 20 words a minute (plain language or code) and be capable of elementary maintenance of wireless transmitting and receiving equipment. Salary according to age in scale £330 rising to £420 a year with all found, including clothing and canteen stores. Candidates should be keen young men, between 20 and 30 years, preferably single, of good education and high physical standard with a genuine interest in polar research and travel and willing to spend 18 or 30 months under conditions which are a test of character and resource. Write to the Crown Agents, 4 Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M2C/41024/PE. [3934

CHIEF Flying Instructor required urgently. Apply Manager, Luton Flying Club, Luton, 4426. [3919

AN opportunity occurs for a senior development engineer in a nationally-known company in the Midlands supplying precision machined components for the gas turbine industry.
THE successful applicant would be required to liaise with the industry to determine design and manufacturing trends, and would be responsible for the development and methods and special machines, in order to attain economic and efficient production.
HE would be responsible to the chief planning engineer for pursuing development through design and manufacturing stages, would require a high degree of initiative and a wide knowledge of manufacturing methods. Salary commensurate with responsibility.
APPLICATIONS in the strictest confidence to Box 4992. [3960

WANTED. Pilots with minimum 1,000 hours Command experience on Constellation aircraft. Two years contract. Apply with minimum salary required to Box 4786. [3911

VICKERS-ARMSTRONGS
(AIRCRAFT) LIMITED
WEYBRIDGE, SURREY

propose appointing several instructors for their new Apprentice Training School during the next six months.

(v) Applications are invited from qualified craftsmen, preferably with experience in instruction in the following trades:

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TURNER AND SKILLED MACHINIST

AIRCRAFT ELECTRICIAN

ELECTRONICS

Applicants should have a particular interest in apprentice training and youth activities and be ready to help in organising out-of-hours activities as well as formal training.

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Weybridge is 30 minutes from London on the main Waterloo/Portsmouth line.

Additional 'buses operate to and from the works at starting and finishing times.

Canteen facilities.

Applicants should be in a position to arrange their own housing accommodation. Assistance can only be given with individual lodgings.

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AIRPORT WORKS
CAMBRIDGE

INSPECTORS (AIRFRAME & ELECTRICAL)

(Housing available to applicants fulfilling specific requirements)

FITTERS (AIRFRAME & ASSEMBLY)

ELECTRICIANS

Some of these vacancies will have special appeal to highly skilled tradesmen interested in Experimental or T.I. Work.

Long-term employment available on modern types of Service and Civilian Aircraft (including Passenger and Transport).

Excellent hostel or lodging accommodation available and in certain circumstances subsistence allowance is paid.

All applications to

EMPLOYMENT OFFICER

SITUATIONS VACANT

EAGLE AVIATION, LIMITED, require experienced Traffic Officers. Applicants should write giving details of age, experience, etc., to the Senior Traffic Officer, Eagle Aviation, Limited, Blackbushe Airport, Camberley, Surrey. [3935

ENGINEER with Canadian Licences covering Lockheed Hudson Wright Cyclone Engines for 15 months contract in Caribbean. Apply Chief Engineer, Hunting Aerosurveys, Limited, Elstree Way, Borehem Wood, Herts. [3932

EDGAR PERCIVAL AIRCRAFT, LTD., require a Chief Inspector, and Inspectors at their works at Stapleford Tawney Aerodrome in Essex. Replies giving full details of experience and salary required must be addressed to the firm's London Office at 72 Chesterfield House, Curzon Street, London, W.1. [3934

MARSHALL

AIRPORT WORKS CAMBRIDGE

AIRCRAFT DESIGN AND DRAWING OFFICE

have vacancies for

DRAUGHTSMEN (SENIOR)

DRAUGHTSMEN (INTERMEDIATE)

STRESSMEN

The Design and Drawing Office is engaged on modifications, trial installations and development work, including radar and electronic installations. The work is on a wide variety of multi-jet aircraft, Turbo-Prop Airliners and Guided Weapons.

Excellent salaries and long-term prospects.

Modern office and equipment.

Housing available.

Applications, with full details and stating when available for interview, to:—

PERSONNEL MANAGER

SITUATIONS VACANT

FIELD AIRCRAFT SERVICES, London Airport, have immediate vacancies for the following personnel:—

Flight engineers, licensed A and C on Viking and Hercules.

Flight engineers, licensed A and C on Viscount and Dart.

Aircraft electricians.

Radio mechanics.

Airframe and engine fitters.

Please apply in writing. [3941

DAN-AIR ENGINEERING, LTD., have the following vacancies at their maintenance base at Lasham Airfield, nr. Alton, Hants. Tel.: Herriard 282.

(a) Deputy chief inspector. To hold A. and C. licences on Dakota, York, Pratt and Whitney and Merlin.

(b) Licensed engineers with any of the above licences.

Write or contact chief engineer at the above address. [3961

RADIO Officers are required to serve with West African Airways Corporation, Lagos, Nigeria (an associate of B.O.A.C.).

APPLICANTS must hold current first-class radio telegraphy operator's licence.

BASIC salary scale of £850-£1,150 p.a. plus £300 p.a. expatriation allowance. Furnished accommodation provided. Free medical service and insurance is arranged and generous home leave is given with free passages to and from U.K.

APPLICATIONS in writing to Staff Manager, Subsidiaries, British Overseas Airways Corporation, Airways House, Great West Road, Brentford, Middlesex. [3952

OWING to further rapid expansion of the Aircraft Division of Louis Newmark, Ltd., at New Addington, the following personnel are required in their Development Drawing Office for work on instrumentation, servo mechanisms and similar equipment.

1. DESIGNER with stress experience.
2. DESIGNERS.
3. DRAUGHTSMEN.

SALARY according to experience and qualifications, pension scheme, excellent working conditions etc. Apply: Personnel Officer, Louis Newmark, Ltd., Prefect Works, Purley Way, Croydon. [3955

DEVELOPMENT engineers and technicians required in research department of a well-known firm of precision engineers, particularly for work in connection with servo systems, small precision motors, and gyroscopic instruments. Apply stating age, experience and salary required to S. G. Brown, Ltd., Shakespeare Street, Watford, Herts. [0146

SITUATIONS VACANT

CHIEF PRODUCTION ENGINEER required for Scottish Aircraft Factory. Proven record in the aircraft industry essential. Four figure salary. Pension scheme. Applications should give details of age, record, and names of three recent referees to whom reference will be made. This is a top appointment for an experienced man. Box 4966. [3940

APPLICATIONS are invited from Draughtsmen-designers experienced in electro-mechanical equipment, mainly for aircraft. Excellent working conditions in pleasant surroundings in South Wales, 24 miles from Cardiff and coast; alternatively, in Nottingham or Reading. Apply, giving full particulars, to Chief Engineer, Teddington Aircraft Controls, Ltd., Cefn Coed, Brecon. [3898

AERONAUTICAL AND MECHANICAL ENGINEERS

ARMSTRONG SIDDELEY MOTORS

require

RESEARCH AND DEVELOPMENT ASSISTANTS

for their Aerodynamics, Combustion Departments and Mechanical Engineering Laboratory. A Degree, Diploma or Higher National Certificate in either physics, aeronautical or mechanical or electronic engineering is necessary. Salaries are good, varying with age and experience. Generous pension and insurance schemes, medical assistance scheme for families. Applications, with full particulars of age and experience, to **Reference CG/AME, Technical Personnel Officer, Armstrong Siddeley Motors, Coventry.**

TECHNICAL ENGINEERS

The Aircraft Division of The Bristol Aeroplane Company Limited has vacancies at Filton for Technical Engineers in the Engineering Development Laboratory.

The work covers a wide field of general aircraft structural and mechanical test rig design and testing, material tests, fatigue tests, and the development and use of electronic equipment. The facilities are some of the most modern and extensive in the country, and a wide range of work is in progress.

There are vacancies in Junior, Intermediate and Senior grades. The qualifications required are a Degree or Higher National Certificate, or equivalent, in an appropriate field, and some experience of similar work, with a knowledge of aircraft drawing office practice for the Intermediate and Senior grades.

Good salaries, working conditions and prospects, together with the pension and welfare schemes, make employment with the company an attractive proposition well worth considering.

Applications, giving details of experience, qualifications and salary required, quoting **D.O.43**, should be addressed to the

Personnel Manager,

The Bristol Aeroplane Company Limited Aircraft Division, Filton House, Bristol.

THE BRISTOL AEROPLANE COMPANY LIMITED

LONDON DESIGN OFFICE

The Company has now fully established its London Design Office in Central London, and Design Teams are actively engaged with Aeroplane, Helicopter and Guided Weapons problems.

These Design Teams work under the finest conditions in the centre of London at salaries appropriate to experience and qualifications. Promotion is given according to merit and a contributory pension scheme ensures the future. There is a luncheon voucher scheme.

Vacancies still exist in the various sections of the Design Teams and applications are invited from those interested in a career.

(a) **Aircraft, Mechanical, Electrical and Structural Draughtsmen** for the Structures, Electrical and Mechanical Sections of the Design Teams.

(b) **Mechanical, Radio and Electronic Draughtsmen** for the Guided Weapons Design Teams.

(c) **Aeronautical, Mechanical and Civil Engineers** with a Degree for the more senior posts (or professional equivalent) or a Higher National Certificate for the other posts in the Structures Analysis and Aeroelasticity Sections Design Teams.

(d) **Aircraft Loftsmen** for the Aircraft Full-scale Layout Section.

(e) **Lady Tracers** for the Aircraft Tracing Section.

Applications, giving details of experience, qualifications and salary required, quoting L.D.O.6, should be addressed to the **Personnel Manager, The Bristol Aeroplane Company Limited, Aircraft Division, Filton House, Bristol.**

SITUATIONS VACANT

JIG and Tool Draughtsmen required, preferably with experience on aircraft assembly jigs. Good welfare facilities, staff pension scheme. Applications in writing to Personnel Manager, Hunting Percival Aircraft, Limited, Luton Airport, Beds, stating age, qualifications experience and salary required. [3950

EDGAR PERCIVAL AIRCRAFT, LTD., require a Technical Writer experienced in small commercial aircraft, for the preparation of manuals of an aircraft now under construction, and for other interesting projects. Reply giving full details of experience and salary required to the firm's London Office at 72 Chesterfield House, Curzon Street, London, W.1. [3937

SENIOR Planning Engineer required, with experience of aircraft manufacture. Applicants must have had a sound all-round experience and be conversant with modern production control methods as applied to this type of work. Full particulars in writing to: Personnel Manager, Field Aircraft Services, Limited, Nottingham Aerodrome, Tollerton, Nottingham. [3931

REQUIRED by major oil company for employment in British Borneo qualified aircraft engineer, approximately 30/35 years of age, single preferred but married man considered. Should possess A and C Licences endorsed for airframe and engine in line with paragraphs 5.4 and 6.3 of A.R.B. Notice No. 10. The post is with the maintenance organisation for a fleet of aircraft as covered by paragraphs 5.5 and 6.4 or A.R.B. Notice 10, to which helicopters may be added in future. Makers instruction courses would be arranged to assist successful candidates to obtain necessary licence extensions before departure overseas. Basic salary in line with experience plus local allowances, pension fund and all travelling expenses paid for interviews in London. Write giving full details age, experience, etc., to Box ZA.313, Deacon's Advertising, 36 Leadenhall Street, London, E.C.3. [3936

SIR GEORGE GODFREY & PARTNERS LTD.

of Hampton Road West,

HANWORTH, MIDDLESEX

invite applications for the following vacancies for work in connection with aircraft pressurization and allied subjects.

RESEARCH GROUP

Engineers of B.Sc. standard preferably with experience of thermo and gas dynamic studies to join a Research Group investigating problems of heat flow in supersonic aircraft. This work forms part of a systematic study which will extend over a period of years.

DESIGN DEPARTMENT

Design and Detail Draughtsmen, Checkers, Stressmen and Technical Assistants with O.N.C., H.N.C. (Mech.) or equivalent, for interesting and varied work in connection with the above.

TECHNICAL LIAISON DEPARTMENT

Engineers for technical liaison duties, preferably with experience of aircraft industry or with R.A.F. or R.N. service. Capable of dealing with technical and maintenance problems in the field.

DEVELOPMENT DEPARTMENT

Development Test Engineers for work in connection with the testing of pressurizing and air conditioning equipment covering complete systems and components. Previous experience of air flow testing an advantage.

TOOL DRAWING OFFICE

Jig and Tool Draughtsmen with experience of precision mechanical engineering, but not necessarily in the aircraft industry.

Apply to

THE PERSONNEL OFFICER,

giving full details of experience, other qualifications, age and salary required. The vacancies are pensionable and train fares for applicants from outside the London area will be paid if required to attend for interview.

MECHANICAL ENGINEERING DESIGNERS AND DRAUGHTSMEN

ARMSTRONG SIDDELEY MOTORS

urgently require

MECHANICAL ENGINEERING DESIGNERS AND DRAUGHTSMEN

Salaries are good and vary according to age and experience. Generous pension and insurance schemes. Medical assistance scheme for families. Applications with full particulars of age and previous career to **Technical Personnel Officer, Armstrong Siddeley Motors, Coventry, quoting Reference CG/ME7.**

TRANSAIR LIMITED

Croydon Airport

Surrey

Immediate Vacancies

for

DAKOTA CAPTAINS

and

FIRST OFFICERS

Apply:

Operations Manager

THE DE HAVILLAND AIRCRAFT CO. LTD.

have vacancies for

DESIGN AND DETAILING DRAUGHTSMEN

in their Design Offices at

HATFIELD,

LONDON (REGENT ST.),

CHESTER

Excellent opportunities for men with good technical qualifications and practical experience in aircraft or other light engineering.

The Company is engaged on Design and Manufacture of Civil, Military and Naval Aircraft.

Good salaries based on experience and ability. For further information apply to

Personnel Manager (Ref. D.1),
de Havilland Aircraft Co. Ltd.
Hatfield, Herts.

SITUATIONS VACANT

EDGAR PERCIVAL AIRCRAFT, LTD., require Senior and Intermediate Draughtsmen for interesting work on a small commercial aircraft, and for other projects at both Stapleford Tawney Aerodrome in Essex, and at their London (S.W.) drawing office. Replies giving full details of experience and salary required must be addressed to the firm's London Office at 72 Chesterfield House, Curzon Street, London, W.1. [3939

DESIGN ENGINEERS, H.N.C. or equivalent preferred. Good engineering knowledge for development of Aircraft Wheels and Brakes, Associated Hydraulic systems, to meet expanding programme. Also TECHNICAL WRITER/INSTALLATION ENGINEER. Pension Scheme. Excellent opportunities for advancement. Written application to the Personnel Manager, Goodyear Tyre and Rubber Co. (G.B.) Ltd., Birkenhead Rd., Wallasey. [3926

SENIOR Stressman required for interesting programme of project and development work. Previous experience essential, H.N.C. minimum qualification. Salary range £700/£900 per annum. Excellent working conditions. Superannuation scheme. Assistance given re housing. Within easy reach of Bournemouth. Special transport facilities. Full particulars in writing to Personnel Manager, Flight Refuelling Ltd., Tarrant Rushton Airfield, nr. Blandford, Dorset. [3910

A FAMOUS aero engine firm in Midlands has vacancy for engineer with Degree or H.N.C. to carry out special investigations into strength of gas turbine engine components. Applicants with Degree in Physics or Mathematics also eligible. Previous experience not essential. A vacancy also exists for work on the installation of engines in aircraft requiring similar qualifications. Initial salary £600/860 dependent on age and qualifications. Superannuation scheme operating. Excellent prospects. Apply quoting reference SF/S to Box 4641. [3885

VICKERS-ARMSTRONGS (AIRCRAFT) LIMITED

AT HURN DEPOT, Near BOURNEMOUTH, HANTS

on the production of Viscount Aircraft require applicants, with good experience, for both works and staff vacancies as:

(r) **Inspectors for Electrical Installations, Airframes (including final stages), sub-assemblies and detail fitting.**

Applications, quoting date and prefix letter of advertisement, to:

Employment Manager,
Vickers-Armstrongs Limited
(Aircraft Division),
Hurn Depot,
near Bournemouth, Hants

Additional buses operate to and from the Works at starting and finishing times.

Canteen facilities.

Applicants should be in a position to arrange their own housing accommodation. Assistance can only be given with individual lodgings.

Holidays already arranged by applicants for this year taken into account.

SITUATIONS VACANT

MACHINE tool designers and draughtsmen (all grades) required by rapidly expanding organisation. Successful applicants will be required to work eventually in south Devon. Please write, stating salary required, to Centrax Power Units Ltd., Victoria Road, Feltham, Middlesex. [3943

AIRCRAFT inspectors required for details, major assemblies, final erection and flight shed work. Good pay and prospects for suitable men. Apply stating age and particulars of experience to: Personnel Officer, Hawker Aircraft (Blackpool) Ltd., South Shore, Blackpool. [3944

LOUIS NEWMARK, LTD., have a vacancy in their laboratories for a Physicist or Electro-mechanical Engineer for development work on aircraft and allied instruments. Applications are invited from persons with a degree or similar qualifications who have had some industrial experience preferably on work with gyroscope or accelerometers. Good salary and prospects. Apply Personnel Manager, Louis Newmark, Ltd., Prefect Works, Purley Way, Croydon, Surrey. [3953

AUSTER AIRCRAFT, LTD., require the following staff for their new Farnborough office. Technicians experienced in the design of oxygen and pressurisation and allied systems. Also experienced mechanical design draughtsmen and airframe design draughtsmen and stressmen required for interesting new work. Permanent posts at excellent salaries for capable men prepared to help build up this completely new side of our business. Apply in first instance to Personnel Manager, Rearsby Aerodrome, Leicester. Interviews at Farnborough can be arranged as desired. [3896

BRITISH OVERSEAS AIRWAYS CORPORATION have vacancies with various of their associated and subsidiary companies, for pilots. Applicants should have Airline Pilot's Licence with Instrument Rating would be acceptable for the filling of First Officer vacancies. Experience on Dakota, Viking, Dove a desirable qualification. Salary rates are very good but vary according to the geographical position of the company concerned. Applications in writing to Staff Manager, Subsidiaries, B.O.A.C., Airways House, Great West Road, Brentford, Middlesex. [3933

IMPERIAL CHEMICAL INDUSTRIES has vacancies for technicians in its subsidiary company, Marston Excelsior Limited, for (a) stress and design calculations, (b) heat transfer performance calculations. Interesting work includes aircraft components, pressure vessels, guided weapon projects and atomic energy work. Experience in any of these fields would be useful. Excellent working conditions, contributary pension scheme, good prospects. Starting salary ranging between £650 and £1,100 p.a., commensurate with qualifications and experience. Application forms may be obtained from Marston Excelsior Limited, Wobaston Road, Fordhouses, Wolverhampton. [3942

MANCHESTER CORPORATION AIRPORTS DEPARTMENT. Applications are invited from suitably qualified persons for the post of Airport Foreman, Manchester Airport, at a salary in accordance with Miscellaneous Grade IV of the National Scheme of Service Conditions—£465-£545 per annum. The duties will include supervision of portering, aircraft marshalling, freight loading, etc. Further details, together with application form, are obtainable from the Airport Director, Manchester Airport, Wythenshawe, Manchester, 22, on receipt of a stamped addressed envelope. The forms should be returned to the same address by the 23rd July, 1955. Canvassing is prohibited. [3920

SITUATIONS VACANT

AIRCRAFT electrical draughtsmen required by large company for important work in London. Good salary, in addition living allowance paid to applicants coming from outside the district. Pension scheme, excellent conditions. Apply giving particulars of experience and qualifications to Box 4777. [3908

BOOKS, ETC.

"CASH From Your Camera," by Arthur Nettleton, F.R.G.S. Shows how amateur photography can be made to pay for itself by the sale of pictures to newspapers, magazines, calendar publishers, etc., and deals with the many problems involved. 2nd Edition. 7s. 6d. net from all booksellers. 7s. 10d. by post from Iliffe & Sons, Ltd., Dorset House, Stamford St., London, S.E.1.

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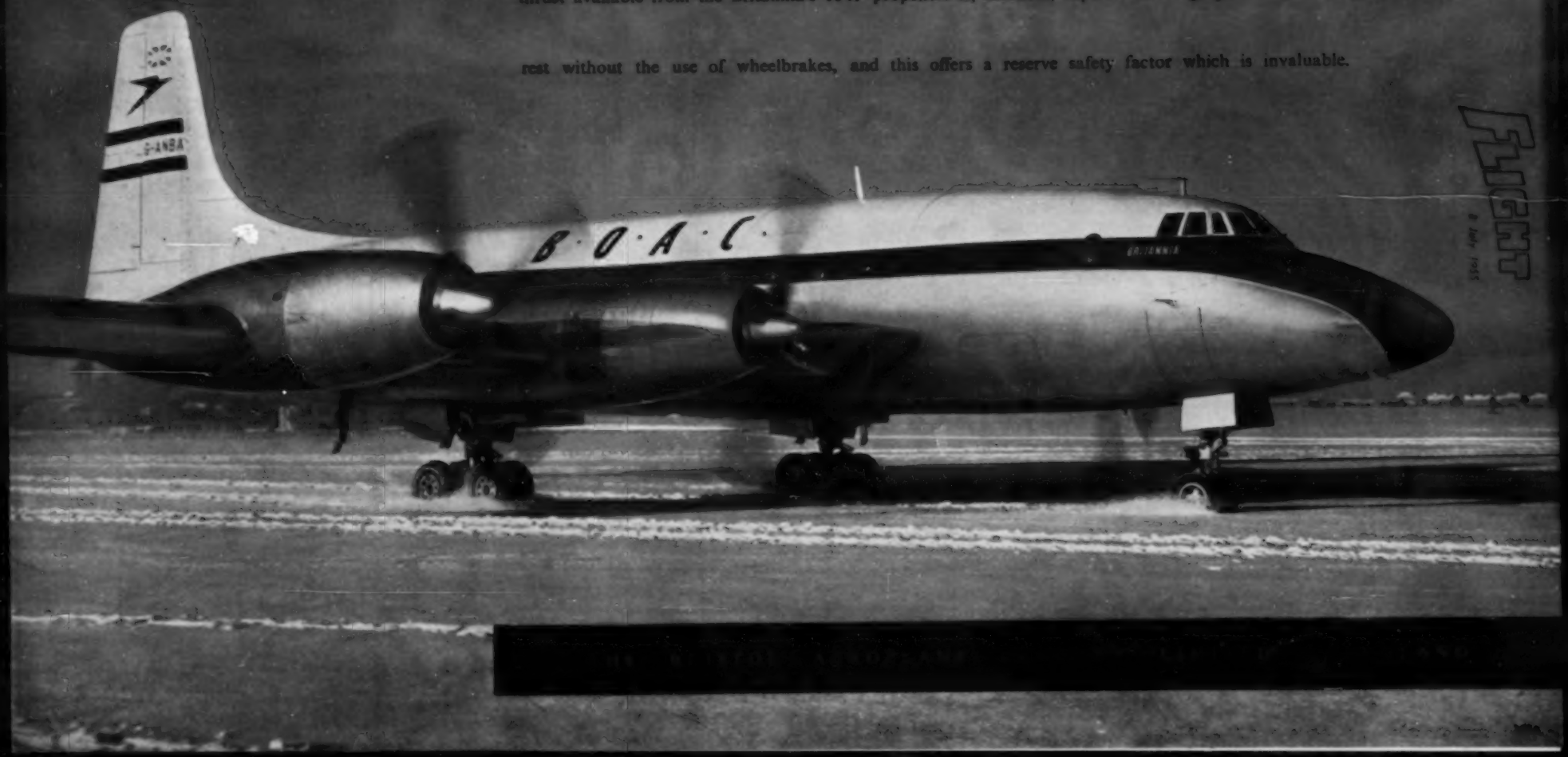

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